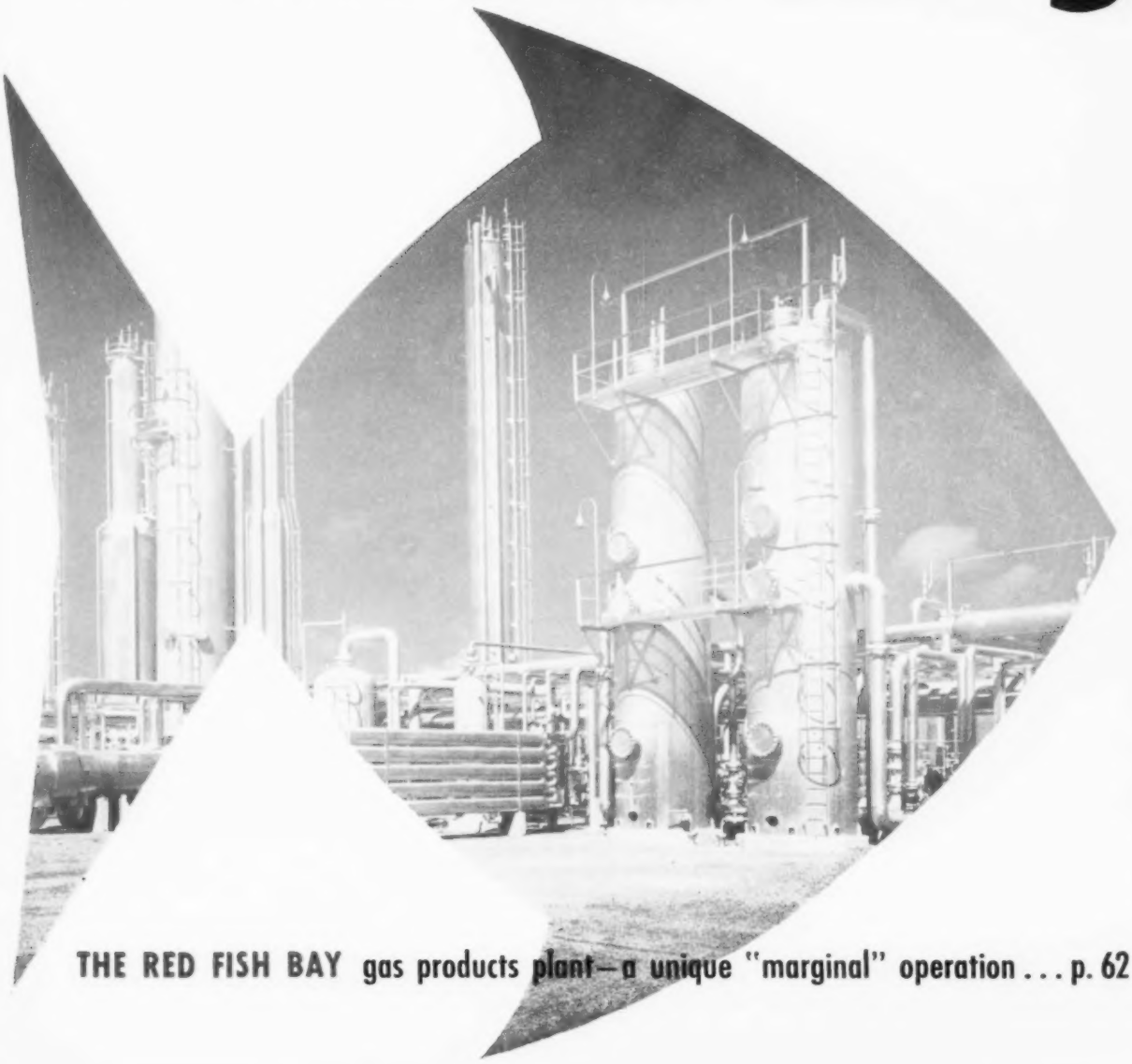
PETROLEUM
REFINING
•
TROCHEMICAL
ANUFACTURING
•
GAS LIQUID
RECOVERY

AUGUST, 1957

Petroleum Processing



THE RED FISH BAY gas products plant—a unique "marginal" operation . . . p. 62

FOR THE DESIGN MAN—a new series on thermodynamics p.43
RADIOISOTOPES AS EVERYDAY TOOLS for the petroleum processor . . p.55
ARE YOU UNDERSTOOD? Here's how to write better memos p.53

A McGRAW-HILL PUBLICATION PRICE ONE DOLLAR

Cooling with Air AND MINIMUM WATER IN A MODERN REFINERY

Process cooling in Cosden Petroleum Corporation's new West Texas refining units is largely by direct use of air. Over 250 million BTU's per hour are dissipated directly to five billion standard cubic feet per day of air moved by 38 fans in HUDSON Solo-aire or Combin-aire units.

Solo-aire units are used where low effluent temperatures are unnecessary. Combin-aire units, in which air is first precooled with water, are used where lower effluent stream temperatures are required. The cooled water from the Combin-aires is available for other cooling services; the Combin-aires in this case performing the further function of water cooling towers. Water spray, carryover or condensation is impossible as the effluent hot air is under saturated with water vapor. Combin-aires are installed adjacent to other process equipment.

These Solo-aires and Combin-aires at Cosden, and hundreds of other HUDSON units in oil, gas and chemical processing plants confirm the advantages of cooling with maximum air and minimum water.

Before finalizing design of new process units, let HUDSON assist you in determining optimum balance in use of air and water.

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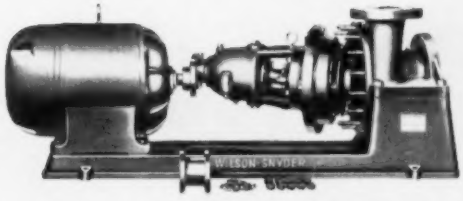


Particularly designed for Processing Services at high temperatures to 900° F., high vapor pressures to 600 psi, and high discharge pressures to 750 psi.

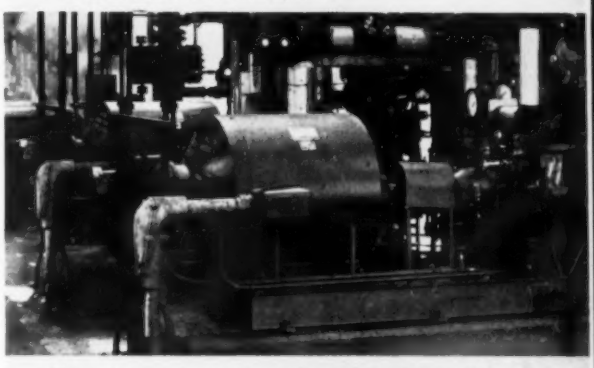
Available in 20 sizes from 15 to 2,000 GPM, 50 to 1,100 foot head, and 2 to 250 horsepower.

...perform a wide variety of processing services!

Very few pumping jobs are exactly alike. Each application involves various combinations of capacities, temperatures, differential heads and liquids with their individual characteristics and material requirements. Typical applications are illustrated here.

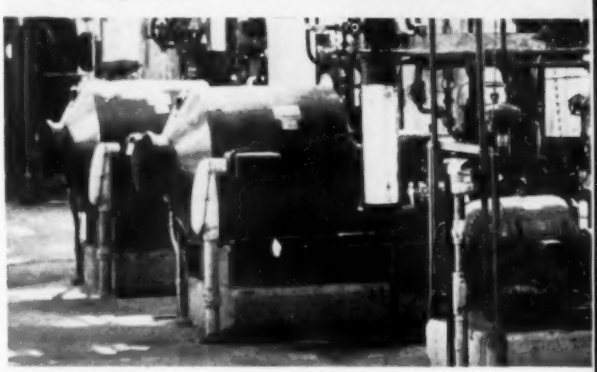
Yet . . . in addition to the broad capacity, temperature, and head range at high efficiency and the extra long service life that is inherent in Wilson-Snyder Centrifugal Process Pump design . . . a surprisingly small inventory of maintenance parts is required to service all sizes. Only THREE SIZES of bearing bracket assemblies, including shafts, sleeves, bearings and packing need be stocked to service all of the TWENTY pump sizes in the line.

This is why so many users are finding it extremely economical and practical to standardize on these pumps for all requirements within the scope of their application.



These Vacuum Tower Intermediate Reflux Pumps (size 6x8x10½" ES — Top Suction) handle Hot Oil of .672 specific gravity at 550° F. pumping temperature with 318 ft. differential head with capacity range from 1365 to 1570 GPM with 150 HP driving motors.

On the "Cat Cracker" Unit, these pumps (size 3x4x16" ES — Top Suction) handle Low Pressure Distillate of .739 specific gravity at 100° F. pumping temperature with 815 ft. differential head and capacity of 254 GPM with 150 HP driving motors.



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Reader's Guide

What's New in Petroleum

A NEW SERIES

For design engineers

Thermodynamic Properties of Pure and Mixed Hydrocarbons

Four articles aimed at bringing you fresh, up-to-the-minute information on methods for determining thermodynamic data. Authored by men with know-how: Merk Hobson and James H. Weber, of the University of Nebraska, and previous contributors of helpful design engineering articles.

The complete series will cover these subjects:

Part I —Latent heats of vaporization of pure hydrocarbons.

Part II —Latent heats of vaporization of mixtures of hydrocarbons.

Part III—Enthalpy and entropy data for pure hydrocarbons.

Part IV —Enthalpy and entropy data for mixtures of hydrocarbons.

These articles are slanted to your current needs. They do not include basic material that can be found in any good thermodynamics textbook. They do include much new and original information. For Part I in the series, please turn to **p. 43**

I II III 2

THIS MONTH'S M&C

More payoff from models

Already a design man's tool, they can also aid in construction projects. Southwestern Editor Ron Cannon tells how "Models Simplify and Cut Costs of a Big Revamp Job," in this case Humble Oil's alkylation unit at the Baytown refinery. **p. 48**

And this month's M&C problem corner continues with an answer to the problem of reducing leaks from mechanical seals in equipment in propane service, as well as an answer to how to cut down on wear in gear pumps in asphalt service. **p. 52**

I 3 4

Do your ideas get across?

Do your thoughts get through? Do people get confused every time they read your short notes and reports? Here's solid help for you from Stu Boynton who tells you how to improve your skills in this most important chore. **p. 53**

I II III 1 2 3 4 5

Radioisotopes—an everyday tool

Ubiquitous Stu Boynton gives you a rundown on some simple, low-cost radioisotopes that can be used in many applications. A do-it-yourself example, measuring sediment density in pipes, is included. See "Radioisotopes — the Refiner's Everyday Tool" on **p. 55**

I 3 4 5

PETROLEUM PROCESSING
A McGRAW-HILL PUBLICATION
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VOL. 12—No. 8

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Processing for August, 1957

Technical tips for you

Today's up-to-the-minute data from operating men and engineers. The sixth in our 1957 series of articles from the popular question-and-answer session of the WPRA fall meeting. See "Catalytic Reforming Problems." p. 59

I 3

COVER STORY

"Marginal" lean-gas operation pays off

How do you make a lean-gas operation profitable? It's not easy. But a joint operation near Corpus Christi is doing well on inlet gas with less than 1 gal/mcf. Southwestern Editor Ron Cannon describes its design features on p. 62

III 2 4

Butadiene plant makes big news

The plant, of course, is Texas Butadiene & Chemical's privately financed installation near Houston. It's the first butadiene plant built since World War II and it's now onstream. An unusual lineup of processes turns out both butadiene and avgas. p. 66

II 2 3 4 5

How to meter volatile liquids

Project engineer George E. Batchelder tells how to minimize vaporization of highly volatile liquids during handling operations, and offers six important rules for a correct volatile liquid metering installation. p. 70

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AND IN THE FUTURE

Keep Your Eyes Peeled

. . . for those upcoming issues of this magazine. There are plenty of reasons for getting right down into your favorite chair for a bit of good reading.

For example:

● The second special industry report of the year. In next month's issue, you'll find our sixth annual survey of the petrochemical plants in the United States and Canada, plus timely discussions of today's important petrochemical products.

SUBSCRIPTIONS are solicited only from executives, supervisors, engineers, and other technical personnel engaged in petroleum and petrochemical research and development, and in the design and engineering, operation, maintenance and construction of petroleum refining, petrochemical processing and gas-liquids-recovery plants. **Position and company connection must be indicated on subscription orders.**

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Continue "Readers' Guide" on p. 75

HOW TO USE IT:

Your new "Readers Guide to What's New in PETROLEUM PROCESSING" will do two things for you. First, the key numbers with each article will tell you at a glance if it is within your scope of interest: roman numerals indicate industries; arabic numerals show fields of activity. Secondly, the longer descriptions will tell you what each article is about, and why it can be of help and interest to you—THE EDITORS

Advertisement

Ethyl Research Performance of Today's

by T. W. Warren

Director, Refinery Technology, Ethyl Corporation Research Laboratories

A premium fuel being road tested in one of Ethyl's controlled-weather rooms that duplicates road conditions exactly.

(To obtain more data on advertised products see page 126)

Advertisement

Reports on Premium Fuels

NINETY-ONE premium gasolines and 12 third-grade super-premium fuels have been tested on the road and in the laboratory in a research program recently completed by Ethyl's Detroit Research Laboratories.

The results of this investigation have been published in a 140-page report entitled "Antiknock Behavior of Premium Motor Fuels, 1957", now available to all companies in the Oil and Automotive Industries.

The fuels tested were submitted by 83 refineries of 48 American companies. These refineries produce 75 per cent of the motor fuel in the United States. Seven Canadian companies, producing an appreciable percentage of Canada's gasoline needs, also submitted fuel samples for testing.

Each Gasoline Tested 32 Times

Five 1957 cars normally requiring premium fuels, and three cars equipped with experimental 11 to 1 compression-ratio engines were used in the tests. A minimum of two Modified Uniontown and two Modified Borderline ratings were obtained for each gasoline in each car, a total of at least 32 road ratings for each fuel sample.

Extensive laboratory data, including determinations of tetraethyllead susceptibility, hydrocarbon type, and bromine number, were also obtained and are included in the report.

Test Results Point to Future Gasoline Developments

The broad sampling of premium fuels tested gave an accurate picture of today's premium gasolines and how they perform in the cars of today and in the higher compression engines of tomorrow. A complete analysis of all the test data led to the following conclusions affecting refining economics:

1. Sensitivity (the difference between Research and Motor octane number) often is an unreliable measure of road performance through the normal speed range.

2. Research and Motor octane numbers can be used to predict road performance at low speeds but are less reliable at intermediate and high speeds.

3. At higher speeds, road performance increases when the aromatic content of the gasoline is increased.

The 103 premium and super-premium gasolines in these drums were tested for Ethyl Corporation's 1957 premium fuel survey. This is the fifth premium survey conducted by Ethyl since 1946.

An important by-product of this program was the development of a system for calculating the road octane number of a gasoline. This development will permit individual refiners to determine the "road octane number" of their gasoline blends using the results of simple laboratory tests.

How Ethyl Research is helping you

Since World War II, Ethyl Corporation has investigated the laboratory and road performance of premium-grade gasolines in 1946, 1949, 1951 and 1954. During this period, the number of fuels analyzed has increased from 12 gasolines in 1946, to 63 in 1954 and 103 in 1957.

"Antiknock Behavior of Premium Motor Fuels, 1957" is one more example of Ethyl's continuing service to the Oil Industry. Copies can be obtained from your Ethyl Representative or by writing Ethyl Corporation, 100 Park Avenue, New York 17, N. Y.

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New York 17, N. Y.

ETHYL ANTIKNOCK COMPOUND — ETHYL CORPORATION

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 (To obtain more data on advertised products see page 126)

186,000 BBLS. IN NEW STORAGE CAPACITY, AND—

...THE INSTALLATION OF FLOATING ROOFS PAID OFF IN JUST 6 MONTHS!

It happened at Knoxville, Tenn. That's where General American built a 6-tank terminal—including a 55,000 bbl. jet fuel pipeline storage tank—for Republic Oil Refining Company, a Division of Plymouth Oil Company.

"General American's unique experience in constructing and operating their own terminals helped us with our problems," says Holland Howell, Republic's chief engineer. "What's more, we found General American's 12-18 month payout estimate quite conservative. Through savings in filling and breathing losses alone, *the installation of floating roofs paid off in only 6 months!*"

As a result of this proved performance—speedy, dependable construction, definite savings and improved safety through use of Wiggins Floating Roofs—General American was authorized to build additional facilities for Republic. At Belton, South Carolina, tanks for the storage of 160,000 bbls. have been completed. At Doraville, Georgia, General American is now erecting a 110,000 bbl. sales terminal, and will erect another terminal at Macon, Georgia.

It pays to plan with General American

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Petroleum Processing

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Platt's Oilgram Price Service

Dear Reader...

. . . "Whatcha fishing for?" —We had a lot of comments of that sort when we were testing designs for this month's cover—including one staffer who exclaimed "Yipes! A cod liver oil plant!"

I'll admit the design is a little unusual to be gracing the front of a technical magazine. Also, it could be more correct. We did some researching and learned from our publisher that there is a Red Fish (he caught a 6½-pounder in Matagorda Bay last month); but it's a long, narrow piscatorial specimen that wouldn't fit our cover shape. So our art director (Bill Caperell, who breeds tropical fish as a hobby) crossed a Red Fish with an Angel Fish. The result is swimming around on the front of this issue.

I think it's a good cover—good because it does all three of the things we think a cover should do for the people who get PETROLEUM PROCESSING:

1—Show you at a glance that this is a brand new, fresh issue of PETROLEUM PROCESSING. (You knew this was a new issue because you were sure you'd never seen THAT cover before.)

2—Catch your attention and cause you to pick up the magazine and look at the cover more closely.

3—Persuade or "sell" you on opening the issue and starting to read or look at what's inside.

From that point on it's up to the contents of the issue to keep you reading and looking. The cover has done its job.

Most of us don't like to think of being "sold"—but please don't take offense at our efforts. After all, we want readers —and we can't make a reader out of you if we don't first get you to stop when you see PETROLEUM PROCESSING, pick it up, and then look inside.

One thing you'll never find on our front cover is a paid advertisement. It's not that we disapprove of advertising or wouldn't like the fancy price a good many firms would be glad to pay for our cover. But we think that particular space is worth a lot more to both you and us as a welcome mat. You might put a billboard on the side of your barn—but not on your front door.

William F. Bland

—Editor

P.S.—To find out how the Red Fish Bay Gas Products Plant makes a profit on a lean-gas operation, don't forget to stop on p. 62 in this issue.

AMOCO CHEMICALS—A NEW RESOURCE

for petroleum additives
for petroleum additives research, testing and technical service

AMOCO Chemicals Corporation is a new resource for petroleum additives. This new resource is implemented by: (1) extensive research facilities for the development of improved additive chemicals, (2) engine test laboratories to help evaluate the performance of your motor oils, (3) men fully qualified through experience to cooperate with you in laboratory and field test programs.

AMOCO Chemicals sales engineers have had years of experience in the proper application of petroleum additives. They are ready to assist you in formulating motor oils to meet the requirements you have established for your products.

Want more information about the petroleum additives research, test or technical service facilities of AMOCO Chemicals? Your request for additional information will receive immediate attention.

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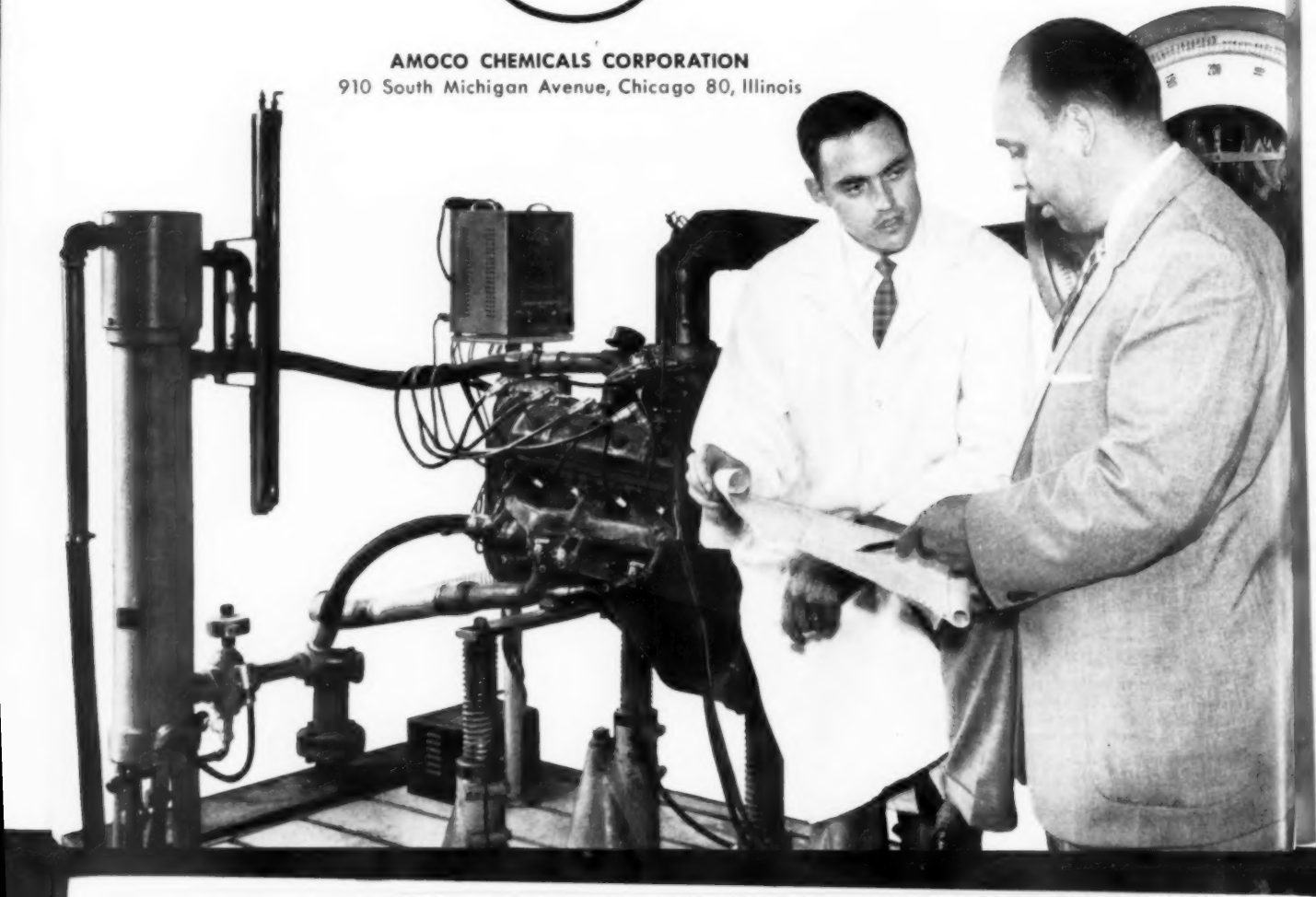


WHAT'S HAPPENING

In Washington

. . . **Petroleum industry** is becoming more competitive according to Anti-trust committee's study of economic concentration. Shipments by four largest refiners declined from 35% in 1947 to 33% in 1954. Eight largest refiners shipped 56% of products in 1954, a 3% drop from 1947. (See p. 10 for synthetic rubber.)

. . . **The U.S. Army Board** has recommended a changeover from spark ignition engines to compression ignition engines for coming Army vehicles. Adoption would mean one less giant market for gasoline.

. . . **Navy** has told Senate Small Business Committee that it hopes to close gap between 8 million bbl of JP-4 that military buys and 25 million bbl that industry says can be supplied. Small refiners are seeking to increase their percentage of JP-4 production.

. . . **Senate** has provided maintenance funds for Rifle, Colo., shale-oil plant. The appropriations bill prevents dismantling of plant, and gives Interior Dept. funds for maintenance only. Navy wants to renew research at contested plant.

In refining

. . . **The Russian Academy of Science** claims to have transformed gasoline into a solid. Report is that gasoline bricks are produced by mixing normal-octane gasoline with plastic compounds in special equipment, then solidifying the mixture under heat and pressure. The bricks are said to be heat and water resistant.

. . . **Jet fuel demand,** worldwide, has now passed demand for avgas. Caltex study predicts avgas demand will level and decline after reaching a 1958 peak of 110-million bbl. Jet fuel use will soar to 275-million bbl in 1968, according to study.

. . . **Sinclair Refining's** "X-Chemical" gasoline additive is made up of tributyl phosphines. The company, which has patented the additive, will license its use abroad.

. . . **International Federation of Petroleum Workers** is planning to expand world-wide jurisdiction and include chemical workers. O. A. Knight, president of IFPW and of Oil, Chemical & Atomic Workers Union believes the expanded IFPW will be the largest labor union in the world. First step is negotiating with the General Factory Workers Union, representing over 1-million chemical workers.

. . . **Cooperative Refinery Assn.,** will add a $1-million hydrofluoric alkylation unit under a UOP license to its Coffeyville, Kan., refinery. It will be built by Refinery Engrg. Co. for early 1958 completion.

. . . **Atlas Processing Co.'s** Penex unit will be the first commercial installation to treat n-hexane exclusively. The 3500-b/sd, UOP-licensed hexane isomerization unit is expected onstream in early 1958.

. . . **British American Oil's** $4-million, 10,000-b/d catalytic reformer is now onstream at Clarkson, Ont. The unit will help triple capacity to over 60,000 b/d. A 4000 b/d cat reformer is nearing completion at Edmonton, Alta. B-A's 20,000-b/d refinery going up at Port Moody, B.C., will also have catalytic reforming.

. . . **Phillips Petroleum** will have Procon engineer and build a 3700-b/sd UOP Platformer, as well as a prefractionator and certain offsite facilities, at its Woods Cross, Utah, refinery. Completion is set for spring '58.

. . . **Utah Oil Refining Co.** is upping capacity of its Salt Lake City refinery to 35,000 b/d as part of an $8.4-million manufacturing expansion program. First step is a $2-million, 6000-b/d crude still to be built by Fluor. Completion: mid 1958. Present still will go on standby.

. . . **Frontier Refining Co.** has got a $1.5-million loan to up capacity of its Cheyenne refinery (PP 7-56p9).

. . . **Champlin Oil & Refining** will have Badger Mfg. Co. build a 1430-b/d hydrofluoric acid alky-

The demand, stocks, trends picture

	1957 to July 19	1956 All July	% Change
Runs to stills	7.855	8.011	— 1.9
Demand			
Gasoline	4.381	4.119	+ 6.4
Middle dist.	1.271	1.293	— 1.7
Residuals	1.344	1.283	+ 4.8
Stocks			
Gasoline	178.267	177.344	+ 0.5
Middle dist.	159.425	146.147	+ 9.1
Residuals	48.314	43.988	+ 9.8

(Figures are in million b/d, API data)

For more details, turn to p. 121, this issue.

lation plant at its Enid, Okla, refinery. The $1.9-million plant is expected onstream by March, 1958.

. . . **Farmer's Union Central Exchange** will add a 4400-b/d naphtha Unifining unit, a 5100-b/d Platformer, and a 7100-b/d middle-distillate Unifiner at its Laurel, Mont., refinery. Refinery Engrg. Co. will build the UOP-licensed units for completion in early '58.

. . . **Shell Oil** will have Procon design and build a 16,000-b/sd combination UOP Platforming-Unifining unit at its Norco, La., refinery for 1958 completion.

. . . **Standard of Indiana** will boost capacity of its Wood River, Ill., refinery by about 30% by replacing its existing 51,200 b/d of crude charging capacity and 25,700 b/d of catalytic and thermal cracking capacity with a 67,000 b/d crude distillation unit and a 30,000 b/d fluid cat cracker. Arthur G. McKee, prime contractor, will start construction this fall. Standard will also add more solid rocket propellant lab facilities at Freeman Field, Ill.

. . . **Shell Oil Co. of Canada** has opened its $1-million, 600-t/d asphalt plant at Montreal East.

. . . **Wilshire Oil Co. of Calif.** has put a new $3.5-million, 10,000-b/d Platformer-Unifiner onstream at its 33,000-b/d Norwalk Calif., refinery.

. . . **El Paso Products** will use most of a $33-million loan to build a refinery and styrene plant at Odessa, Tex., another at Ciniza, N.M., and complete a butadiene plant.

In petrochemicals

. . . **Davison Chemical Co.** will build a $2-million, 200-t/d sulfuric acid plant in Casper, Wyo. The plant, scheduled to go on stream in July, 1958, will use both recovered sulfur from local sources and spent alkylation acid and hydrogen sulfide from nearby refineries as raw materials.

. . . **Shell Chemical** will add an allylamines-producing unit to its Martinez, Calif., plant.

. . . **Solvay Process Div.** of Allied Chemical & Dye will double capacity of its vinyl chloride monomer operation at Moundsville, W. Va.

. . . **Atlas Powder** is taking a significant step in replacing its Atlas, Mo., nitric acid and ammonium nitrate facilities with $4-million-worth of new equipment that will permit sale of some production to outside industrial consumers. The new acid unit, first of the self-sustaining type to go up in this country, will be designed and built by Chemical and Industrial Corp.

. . . **Mississippi Chemical Corp.** will have Chemical and Industrial Corp. design and build a 150-t/d nitric acid plant at existing facilities in Yazoo City, Miss. Onstream date: early 1958.

. . . **Canadian Industries Ltd.** will double capacity of its Edmonton, Alta., polyethylene plant to 40-million lb/yr, using nearby natural gas.

. . . **Union Carbide** will build an ethanol, ethylene oxide, and isopropanol plant near Winfield, W. Va., Initial ethylene oxide capacity will be 150-million lb/yr.

. . . **American Synthetic Rubber** has boosted its Louisville, Ky., capacity from 44,000-long t/yr to 69,000-long t/yr. Cost: $3.5 million.

. . . **Synthetic rubber production** in the U.S. was described this way in the Senate's report on economic concentration: The four largest firms ship 52% by value, the next four largest ship 27%, and the next twelve: 21%.

. . . **Delhi-Taylor Oil Corp.** is now formally in the petrochemicals business. Its new, Treco-built plant at Corpus Christi will produce 45-million gal/yr of high purity benzene, toluene and xylene. Heart of the plant is a combination UOP Platformer-Udex unit.

. . . **Shell Oil** will soon be the third refiner in the Anacortes, Wash., area to fuel its operations with natural gas. Initial delivery of 1.8-billion cu ft/yr will be upped to 2.1-billion cu ft/yr eventually to replace noncondensable oil and fuel oil fuels. Shell thus joins General Petroleum's Ferndale plant and U.S. Refining's soon-to-be onstream Tacoma refinery. Gas may eventually be used for petrochemicals, possibly ammonia.

In gas liquids recovery

. . . **Cities Service** will participate in a gasoline plant to be built in the Laverne area of northwestern Oklahoma. Ultimate capacity: 100-million cu ft/d.

. . . **Sinclair Oil & Gas Co.,** will install an deisobutanizer in its 18-million cu ft/d Gas Products Plant No. 6 at Covington, Okla. The 20,000-gal/d unit is expected be in operation by Jan., 1958.

. . . **United Refining** is adding LPG to its products line.

In foreign operations

. . . **EUROPE—Imperial Chemical Industries** has long-range plans for a $280-million petrochemical plant to go up in Gloucestershire in the Mid 1970's

. . . **Lobitos Oilfields, Ltd.'s** 800-b/sd Platformer,

This Sunday Drive
REQUIRES A 7-DAY WEEK

Today's refineries are working on an around-the-clock basis and one of the reasons is the ever increasing demand for automotive gasoline. With the number of vehicles on the road still increasing, many experts foresee a 4 percent increase in the sale of gasoline and diesel fuel this year.

Polyrad—a filming amine inhibitor and detergent—can help refineries maintain peak production. As a detergent, Polyrad keeps metal surfaces clean to maintain throughput and increase heat transfer. As an inhibitor, Polyrad reduces corrosive damage to a minimum; cuts down time for maintenance.

If you are among the few who are not familiar with Polyrad, a Hercules representative will be glad to discuss how this product can meet your specific requirements. Polyrad is always quickly available from conveniently located stocks throughout the country and overseas.

Pine Chemicals Division, Naval Stores Department

HERCULES POWDER COMPANY

924 King St., Wilmington 99, Del.

REFINERS RELY ON

POLYRAD®

FILMING AMINE INHIBITOR

(To obtain more data on advertised products see page 126)

built by Procon Ltd. is on stream at Ellesmire . . . **Lummus** has started building the $30-million, 40,000 b/d refinery at Whitegate, Ireland, for Irish refining Co. Ltd. (PP7-57p10).

Esso Netherlands is considering expansion of its still-on-paper refinery planned for the Rotterdam area . . . **Caltex Petroleum Maatschappij** has brought a 7500-b/d Platformer, and two Unifiners, 7500 b/d and 4500 b/d, onstream at its Pernis, Netherlands, refinery . . . **Socony Mobil,** and **Hydrocarbon Research** are the two non-Greek firms of the six bidding for operation of the Greek government's refinery at Aspropyrgos.

Schloven-Chemie AG will boost petroleum-processing capacity of its Gelsenkirchen, Germany, plant from .75-million t/yr to 2-million t/yr . . . **Deutsche Shell** will expand capacity of its Hamburg-Harburg refinery to 50,000 b/d and add an 11,000-b/d cat cracker and a 400-b/d cat poly plant. The company's projected 80,000-b/d Godorf refinery will probably be expanded to handle 140,000 b/d in 1960 . . . **Erdoelwerke Frisia,** Swiss industrialist Gottlieb Duttweiler's projected refinery at Emden, Germany, will have an initial capacity of 22,000 b/d, later to be upped to 60,000 b/d . . . **BP Benzin un Petroleum** and **Farbenfabriken Bayer,** will build a 50-50, $56-million petrochemicals plant next to Bayer's Dormagen, Germany, plant. British Petroleum's projected 80,000-b/d refinery for the Ruhr will deliver about 300,000 t/yr of feedstocks to the new plant.

. . . **FAR EAST—Toa Oil Co,** of Japan, is producing enough high-octane gasoline in its new refinery to meet the entire domestic Japanese demand . . . **Pakistan** has asked Burmah Oil, British Shell, Caltex, and Standard Vacuum to submit joint proposals for setting up a Pakistani refinery . . . **Thailand** is considering three bids, one from Foster Wheeler and Summit Industrial, for construction of a 15,000-b/d refinery on Bangkok Harbor. Two smaller refineries, one of 1000-b/d capacity under construction at Farng and another of a probable 5000-b/d capacity will also be built . . . **Stanvac's** proposal for a $40-million, 25,000-b/d refinery in the Philippines has cleared an important hurdle and will now be considered by higher authorities.

. . . **MIDDLE EAST—British Petroleum** and **Shell,** under Arab boycott pressure in Israel, have made no decision on future of their Haifa refinery. . . . **Iraq's** Qiyara bitumen refinery may be converted to production of other distillates, with a possible capacity of 5000 b/d at a $1.5-million cost . . . **Egypt's** Mex refinery, one of nation's three, may be expanded to produce 14,000 b/d (from 4000 b/d). The plant, which was transplanted from Switzerland, is 20%-owned by Caltex (Egypt) SAE, and 10%-owned by the Swiss IPSA. Egypt holds controlling interest.

. . . **LATIN AMERICA—Panama Refining & Petrochemical** has the official OK for its $33-million, 55,000-b/d refinery in Portobelo, which will be made an international port . . . **Intercol's** 26,500-b/d refinery, at Cartagena, Colombia, now nearing completion, will be functionally colored . . . **ANCAP,** Uruguay's industrial entity, will spend $8 million to have its refinery expanded by Kellogg . . . **Copetrol Oil Refining Co., S.A.** expects to have its 15,000-b/d refinery in operation within a year in Nuevitas, Cuba. Grebe & Doremus may do design and construction . . . **Fertilizantes Sintéticos, S.A.** will be Peru's first petrochemical plant. The $9-million Montecatini-supervised plant will go up north of Callao to produce 25,000 t/yr of ammonium nitrate, 5000 t/yr of refined ammonium nitrate, 1500 t/yr of nitric acid, 1000 t/yr of anhydrous ammonia, and 15,000 t/yr of sulfate of ammonium.

In transition

. . . **Union Oil** has consolidated its subsidiaries Brea Chemicals (petrochemicals) and R. T. Collier (carbon) into Collier Carbon and Chemical Corp.

. . . **Texas City Refining** may sell its 30,000-b/d Texas City refinery to a major.

In markets and prices

. . . Sinclair's cost-pass-along advances of 0.2¢ on clean products and 5¢ bbl on heavy fuel, effective June 21 (and followed by others), was crumbling fast in July. In fact, the month was a poor one for prices generally.

At the Gulf, cargo prices for top grades of premium gasoline dipped 0.25¢ as did most grades of distillates. Kerosine was off 0.375¢ and residuals fell 20¢ bbl.

Clean products also ran into trouble in the Midwest. While little attention was being paid to off-season distillates, several refiners fought to maintain their branded gasoline gallonage by meeting within 0.5¢ whatever brokers offered in way of price to flag accounts. Heavy fuels were under pressure late in July after a 10¢ cut to $2.15, Group 3, on June 28. Reports revealed offerings as low as $1.65, Group 3, in one instance and somewhat larger quantities at $1.95 in certain instances.

Charlotte, N. C., meanwhile, attracted widespread attention for having the lowest tank wagon price in the country for regular-grade gasoline. Price troubles in this city brought the dealer price down to 5.4¢ (ex taxes) for regular gasoline. But at the end of the month the city's retail fight appeared about over as higher dealer postings began to appear.

LUMMUS

ENGINEERS AND CONSTRUCTORS FOR INDUSTRY

385 Madison Avenue New York 17, N. Y.

Lummus to Build 200,000,000 lb. per Year Ethylene Plant for Petroleum Chemicals, Inc.

Installation Designed for 50% Expansion

The Lummus Company is presently designing and will build for Petroleum Chemicals, Inc. at Lake Charles, Louisiana a plant to produce 200,000,000 pounds per year of ethylene. Scheduled for completion by the end of 1957, the plant is designed to permit expansion of output to 300,000,000 pounds.

The plant will use Lummus' ethylene process and will draw refinery gases supplemented with LPG from the nearby refineries of Cities Service and Continental Oil, by whom P.C.I. is jointly owned. Ethylene will be made in two grades — the top grade 99.8% pure — the second 98.5%. By-products will be 95% pure propylene, C_4s, and an aromatic distillate.

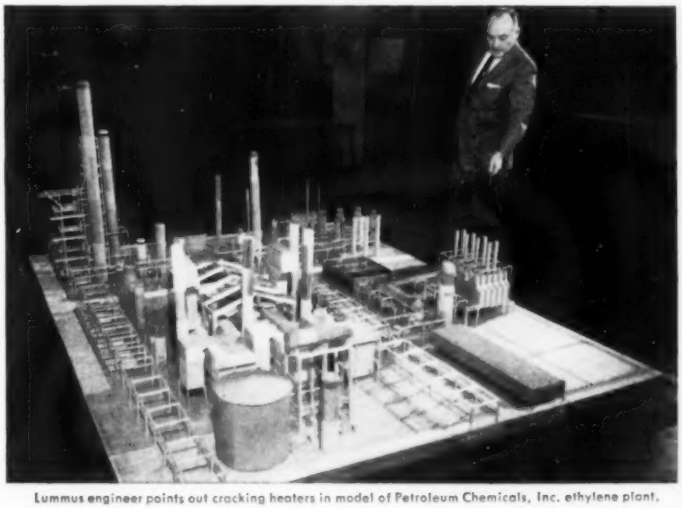
Cracking section of the plant features an improved Lummus heater which embodies years of research and development by Lummus' Heater Division. Equipment in the Lummus-designed low-temperature fractionation unit includes 12,500-hp gas turbines which drive the centrifugal charge and refrigeration compressors; exhaust from these turbines generates high-pressure steam in three waste heat boilers. The system utilizes high efficiency expanders to recover very low temperature refrigeration.

This plant brings the total of Lummus designed ethylene plants to 14, with a combined capacity of over 3 million pounds per day.

Part of the new plant's ethylene output will be sold to Calcasieu Chemical Corporation, which will use it to produce ethylene oxide and glycol in a plant adjacent to the ethylene unit. Lummus is currently designing and will build the Calcasieu installation.

Lummus has over half a century of experience with chemical and petrochemical projects. Why not discuss your next project with a Lummus representative.

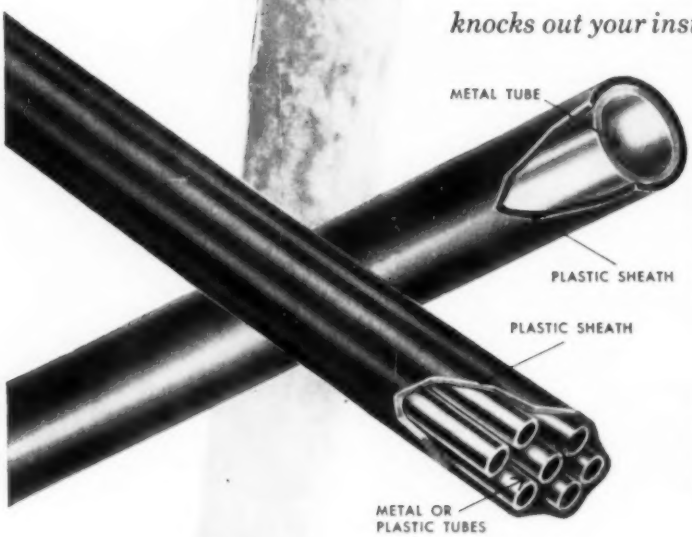
THE LUMMUS COMPANY, 385 Madison Avenue, New York 17, N. Y. *Engineering and Sales Offices and Subsidiaries:* New York, Houston, Montreal, London, Paris, The Hague, Bombay. *Sales Offices:* Chicago, Caracas. *Heat Exchanger Plant:* Honesdale, Pa. *Engineering Center:* Newark, N. J.



Lummus engineer points out cracking heaters in model of Petroleum Chemicals, Inc. ethylene plant.

DEKORON INSTRUMENT TUBING

knocks out your instrument line corrosion problems



DEKORON single-line tubing. Samuel Moore & Co. will coat your copper, aluminum or steel tubing by the Dekoron extrusion process, or will supply coated tubing. Straight lengths to 20 ft., coils to 1000 ft.

DEKORON IMPERVAPAK is a multiple tube harness of plastic or metal tubes encased in tight plastic sheath. Multiple tube construction cuts down installation costs.

Corrosion endangers the life line of your plant—your instrument tubing. That's why you should investigate Dekoron instrument tubing, the tubing that's impervious to moisture, salt air, corrosive atmospheres, and chemicals.

That means Dekoron eliminates replacement costs and maintenance. Other advantages are low initial cost . . . less plant down time . . . easy installation with standard fittings and plastic tape.

In replacement savings alone—not including lower maintenance and installation costs—Dekoron Instrument Tubing pays for itself over and over again.

AA-766

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SAMUEL MOORE & COMPANY

DEKORON PRODUCTS DIVISION

MANTUA, OHIO

(To obtain more data on advertised products see page 126)

Petroleum Processing

TOMORROW

By ALAN CORNERETTO, Assistant Editor

Higher octanes in motor fuel are not necessarily the answer

THE next few octane boosts in motor fuels already in the 100-octane range may not be actual octane increases. They may come from improvements in the product itself, fuels that will significantly reduce the octane requirements of present-day engines.

As a result, refiners may be able to get by for a while without costly octane-boosting processes. Esso Research and Engineering, for example, recently released information on its studies of engine deposits—known octane robbers—caused by modern fuel components, including lead additives.

The Esso studies pinpointed aromatics as the worst of the lot; about three times as bad as paraffins in forming deposits. Olefins, it said, are about halfway between aromatics and paraffins.

In addition, Esso found that lead deposits—long known as a culprit inside the engine—are actually encouraged and increased by carbonaceous deposits. The feeling is that a reduction in hydrocarbon deposits will also reduce lead deposits.

What this means is that refiners now know what components to blend into cleaner-burning fuels to cut substantially the octane requirements of engines.

New additives will also help. The Ethyl Corp. has announced a new organic compound of manganese that supplements the anti-knock action of tetraethyl lead. The new compound, tentatively named AK-33X, has been tested in aviation gasoline, and is said to lower an engine's octane requirements and permit power gains of up to 20%. Although the compound has been given full-scale testing in aviation engines only, it may well find similar uses in motor fuels also.

Another company, Sinclair Refining Co., is already using a gasoline additive that is said to reduce engine fouling and octane needs. The additive, a mystery "X-Chemical" until recently, has been identified as tributyl phosphine.

The octane pattern could be taking a new turn. These developments might well delay the day when refiners will be forced to turn out a maximum octane fuel—hazily hinted to be somewhere around 110 RON.

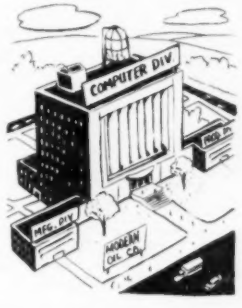
There is general agreement that each octane increase over the 100 mark is going to be extremely costly regardless of how it is done. Better use of fuel components now on hand—through better blending and the use of additives—will make the next octane jump just slightly less painful.

—R. E. C.

Are policy-making computers just around the corner?

THOUGH the first generation of industrial computers has been barely plugged in, the computer's role in tomorrow's petroleum-processing operations is already apparent.

According to specialists of Datics Corp., a Fort Worth computer and data-processing firm, policy-making based on machine data will be common in the oil industry within five years. This will be an outgrowth of work now being done on optimization, operations research, and linear programming.



The accent now on near-term payout problems—production and process engineering, and accounting problems—will be modified as more attention is given to computer solution of tougher long-range puzzlers.

Some of today's specific applications that will make tomorrow's policy decisions easier are: heat and material balances, theoretical flame and effluent composition calculations (important to petrochemicals), refinery optimization, gasoline blending, and gas network calculations.

Soon to receive attention are: instrumentation studies on distillation columns and investigation of unsteady state processes. Accounting applications will continue to be expanded.

Biggest problem ahead will be getting enough skilled specialists. Though manufacturers give some instructions, and universities are now offering computer courses, the oil industry itself will have to train its men adequately.

Some company-wide operations might be coordinated from a central computer station in the near future. But generally, the computer will be put where the problem is—either headquarters or at field locations. Information in the future will probably be computed by small systems and transmitted to central systems for coordination.

Equipment will be improved and "erector" sets may be developed. These sets may be composed of boxes of circuits that could be used in different combinations to do a variety of jobs.

Smaller machines are on the way. There's a de-

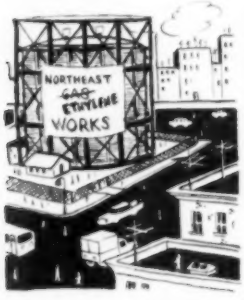
mand for more units to rent for about $2,000/month, for a cheaper automatic plotter, and for tie-in units to link analog and digital computers in the same system.

Consumers of petroleum products are becoming more and more aware of automation. The consumer may believe, tomorrow, that efficient service is impossible without some form of automation.

Independents and other small firms will probably turn to outside help for computing services. These companies will get into the automation whirl as soon as they are shown that they can make a profit by operating their own equipment, renting equipment, or buying outside services. —A. C.

Ethylene from oil gas could be both cheap and efficient

TIMES change and so does the petrochemical situation. On the one hand, ethylene, most of which is made today from ethane or propane, in turn derived from natural and refinery gas, is in great and increasing demand these days. On the other hand, capacity for production of oil gas, a good ethylene source, is standing idle in many existing gas utility plants, according to one authority.



Virgil Stark, president of North American Utility and Construction Corp., has proposed (U.S. patent 2,714,060) a low-cost production method for ethylene and other petrochemicals that seems particularly attractive if existing gas utility plants can be utilized. He claims ethylene could be produced for as little as 1¼ ¢/lb.

The proposal is to produce oil gas by the vapor phase cracking of heavy residuum oils, this oil gas then to be used for the separation, recovery and fractionation of the heavier hydrocarbons (C_2-C_5) by appropriate combinations of compression, refrigeration and absorption.

Hydrocarbon recovery from the oil gas, after separation of the tar, could be limited to C_3-C_5, or extended to include separation of the C_2 hydrocarbons, which could represent an ethylene or ethane yield of as much as 30% by volume.

The residual gas could be purified by sulfur removal, enriched with selected hydrocarbons, delivered under pressure, and used as a substitute for natural gas for delivery by a utility or for use around the plant.

With natural gas becoming generally available, manufactured gas plants are frequently held in standby, or used for peak loads. Many of the gas generators have already been converted for the production of oil gas.

At least one ethylene-from-oil gas operation already exists. The polyethylene that Allied Chemical produces at Tonawanda, N. Y., is based on ethylene extracted from Semet-Solvay's oil gas production. —A. C.

1958 to be year of the borane fuels for military aircraft

FULL-SCALE production of alkyl-borane fuels, set to start next year, means that at least some jets can count on a 40% increase in range soon. Later, if planemakers wish, the higher energy of the new fuels can be used for added speed by cutting engine weight and body size.

Both Olin Mathieson Chemical Corp. and Callery Chemical Corp. have broken ground for plants designed to turn out commercial quantities of the new fuels. Callery's $38-million plant at Muskogee, Okla., will produce Hi-Cal 2, a fuel essentially the same as the HEF-2 and HEF-3 to be made by Olin Mathieson at its $36-million plant going up near Niagara Falls, N. Y.

Olin Mathieson, which has three other facilities producing the boranes, including one that cost $5.5 million, will add another interim producer later this year. The company is also ready with HEF-4, the successor to HEF-3. (The -3 fuel is made from decaborane, -2, from pentaborane.)

The main production steps for the three borane fuels are similar: 1—preparation of diborane, 2—conversion of diborane to pentaborane or decaborane, 3—alkylation. Big difference in all plants is production of the initial diborane.

Though other compounds of lightweight elements have higher energy contents per unit weight and volume than either hydrocarbon or borane fuels, they are not likely to supplant the boron-hydrogen compounds. Hydrogen, with the highest heat of combustion, is handicapped by its very low density, which requires a lot of storage space and an air-borne refrigeration system. Beryllium, the only other element with a greater potential than boron, is in short supply and has extremely toxic compounds. Boron, derived from California's famous borax, is plentiful.

Right now, the boranes look like the ultimate chemical for aircraft. —A. C.

Here's Why
Oil Men Specify –

EC&M
HIGH VOLTAGE STARTERS

2200-4800 VOLTS
FOR
PRESSURIZED ROOMS
OUTDOORS
INDOORS

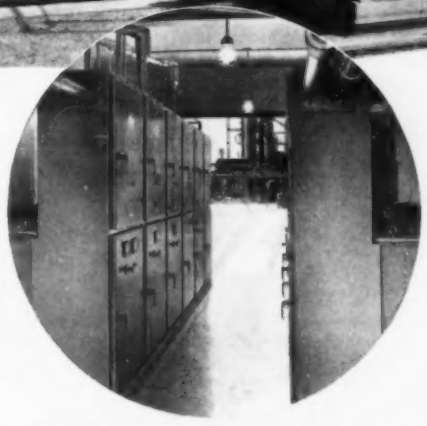
left • Type AH Starter (50,000 KVA, certified) for Division 2 Applications. NEMA 3R (raintight) Enclosures for mounting outdoors
below • Diesel loading pump station in southwestern refinery

EC&M Starters are standardized for *easy selection.* They are *easier to install* because they are shipped with all internal wiring complete. They are designed for *easier, faster inspection and maintenance.* And—they *save valuable space* because they are compact with no sacrifice in accessibility.

EC&M's Type AH Starters are available in NEMA 1 or 3R (raintight) enclosures for outdoors, indoors or pressurized control rooms. Three interrupting ratings: 50,000 KVA—POWER FUSED—and VALIMITOR®

Write for Bulletin 8131-C

Five EC&M Aligning Starters with Incoming Line and Feeder Panels for Pumps and Compressors (Pacific Coast Refinery)



Pressurized Control Room with ten NEMA 1 EC&M Enclosed Starters in midwest refinery

THE ELECTRIC CONTROLLER & MFG. CO.
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Compound your full line of oils with just 2 Oronite® "additive packages"

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Oronite's "detergent package" contains a mixture of detergent compounds—the "inhibitor package" a mixture of inhibitor compounds. Each "package" is specially balanced and formulated to give optimum response with your base stocks. Formulations can be provided to meet any and all performance levels you require.

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The heater in this modern refinery is equipped with new patented **KEY** 5000 type return bend fittings. Leading refineries everywhere use these fittings because they offer dependable and lasting service with real economy.

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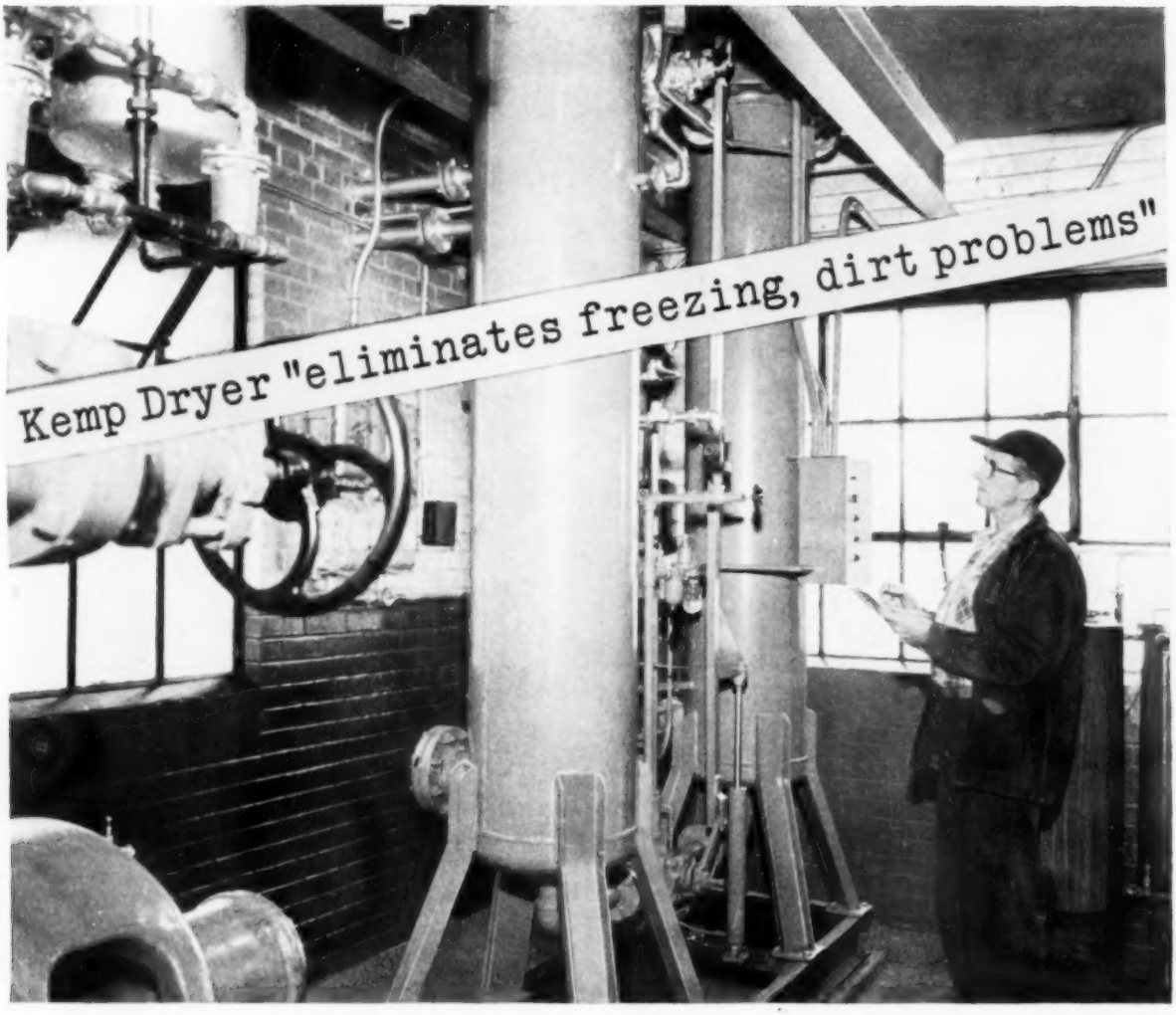

Quaker State Reports: *Kemp Dryer protects instrument lines from freezing at temperatures of 25° below zero*

Instrument failure is now a rare thing at the Quaker State Refining Corp., Farmers Valley, Pa. Quaker State installed a Kemp 300-E Oriad Dryer in December, 1954, and according to Process Supervisor Joe Brown it has really done a job safeguarding instrument operation.

Kemp Saves Time, Labor

The company no longer has to steam trace or insulate instrument air lines. A longer period of time can be allowed between servicing instruments. Even at temperatures of 25° below zero, none of the lines froze. And to further save time and manpower, the dryer is fully automatic! Between its "elimination of instrument failure and ease of operation," Kemp earned its place on the Quaker State team.

Kemp Dryers for Every Purpose

Kemp offers a variety of dryer models to meet all problems. Designed to dry air, gases or liquids to sub-zero dew points at low cost, they are constructed of quality materials and embody the engineering knowledge gained from Kemp's many years of experience. They are available with manual, semi-automatic, or fully automatic tower reactivation. In addition, Kemp will prescribe the proper desiccant for each specific drying job. If you have a problem involving the removal of water from air, gases, or liquids, contact Kemp engineers now. For complete facts and technical information, write for Bulletin D-27.

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CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • INERT GAS GENERATORS
SINGEING EQUIPMENT

THE C. M. KEMP MFG. CO.
405 East Oliver Street, Baltimore 2, Maryland

(To obtain more data on advertised products see page 126)

IMPROVED SHELL LPI PROCESS FOR BUTANE ISOMERIZATION IS 5 WAYS BETTER

Shell's Liquid Phase Isomerization
makes it more economical than ever to
convert n-butane to isobutane

NEW PROCESS SCHEME MEANS:

1. highest conversion of any known process
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4. high stream factor
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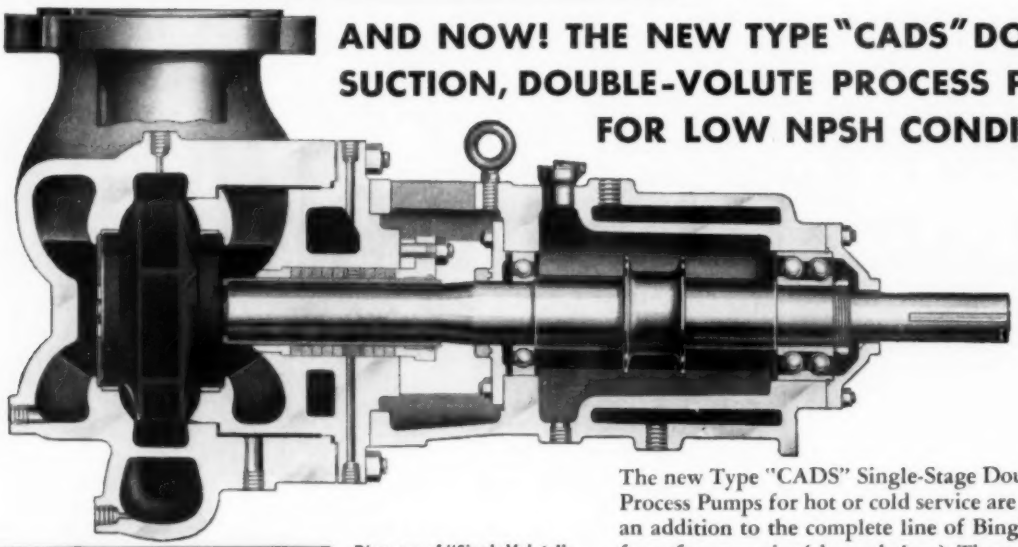
For technical details and cost estimate, see your engineering contractor. LPI process is licensed by Shell Development Company, 50 West 50th Street, New York 20, New York.

SHELL

SHELL DEVELOPMENT COMPANY

Bingham REFINERY PUMPS

designed HOT or including



AND NOW! THE NEW TYPE "CADS" DOUBLE-SUCTION, DOUBLE-VOLUTE PROCESS PUMPS FOR LOW NPSH CONDITIONS

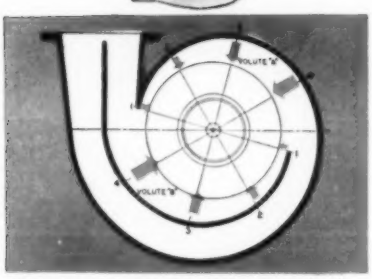


Diagram of a "Double Volute" single discharge case of a single stage pump (above), showing equal pressures on opposite sides of impeller. There is no "SIDE-PUSH"... insuring low maintenance.

Diagram of "Single Volute" pump case (below) showing unequal pressures at opposite points around the periphery of the impeller. These unequal pressures cause "SIDE-PUSH" on the rotating elements, causing wear of rotating parts and, frequently, high maintenance.

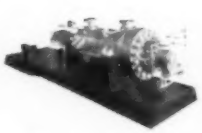
The new Type "CADS" Single-Stage Double-Suction Process Pumps for hot or cold service are available as an addition to the complete line of Bingham Pumps for refinery service (shown below). These new pumps, like other Bingham Process equipment, feature unit-type bearings and rotating assemblies which, with spacer-type couplings, are readily removable without disturbing suction or discharge piping, or drivers.

The new Type "CADS" has a "Double-Suction" impeller with exceptionally large eye areas, thus making it particularly suitable for low NPSH conditions. With a double suction impeller, the stuffingbox is under suction pressure only. The new Type "CADS" has been thoroughly field tested, and has rendered efficient, reliable service — with low maintenance — wherever it has been installed. Your nearest Bingham office will be glad to give you full details on request.

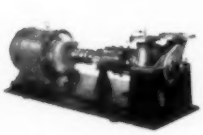
TYPICAL BINGHAM "DOUBLE VOLUTE"

Bingham Type HPD "Double Volute" Multi-Stage Double Case "Hi-Press" pump for extremely high pressure service.

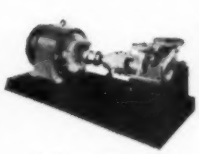
Bingham Type VS Single-Stage "Double Volute" Wet-Pit Pump for high capacity, medium head service.



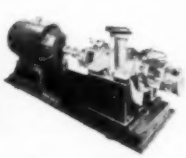
Bingham Type CP "Double Volute" Multi-Stage, Double-Case pump for hot or cold service.



Bingham Type CKA "Double Volute" Single-Stage Koke-Krusher for coke-laden pumpage.



Bingham Type CAD "Double Volute" Single-Stage Process Pump.

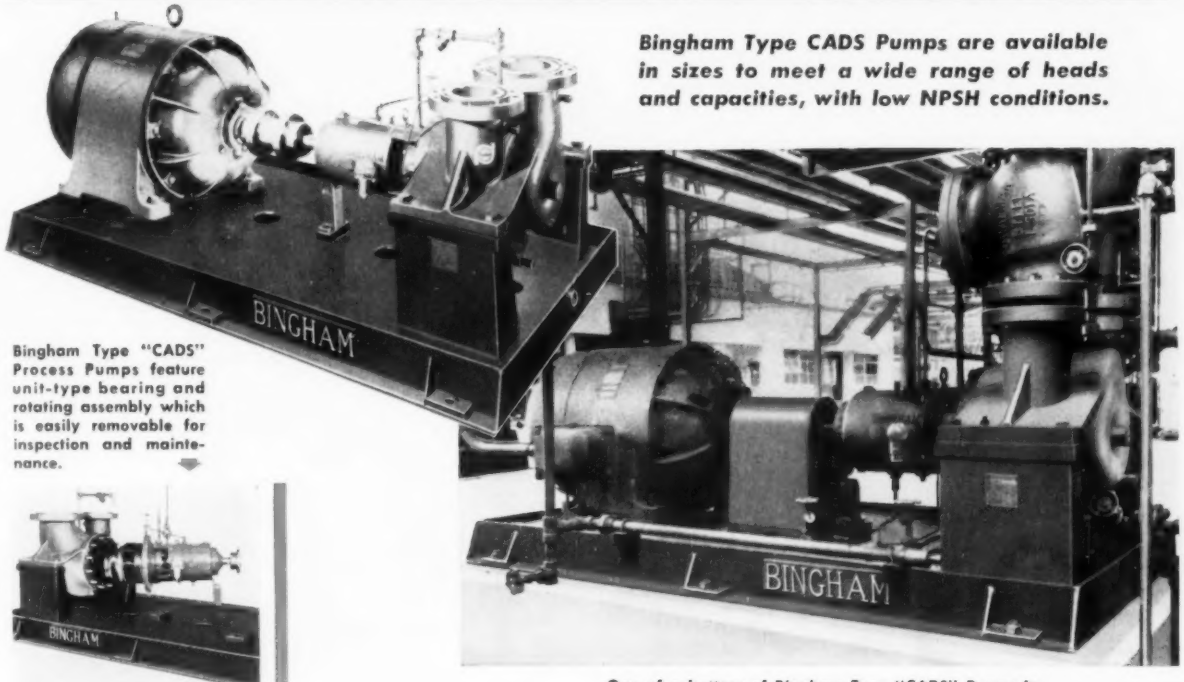


Bingham Type CM vertically split-case two-stage pump for hot service.

to meet all Operating Conditions for

COLD HYDROCARBONS

minimum NPSH requirements



Bingham Type CADS Pumps are available in sizes to meet a wide range of heads and capacities, with low NPSH conditions.

Bingham Type "CADS" Process Pumps feature unit-type bearing and rotating assembly which is easily removable for inspection and maintenance.

One of a battery of Bingham Type "CADS" Pumps in operation at Gulf Oil Co., refinery, Port Arthur, Texas.

Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY

General Offices: **2800 N. W. Front Avenue, Portland 10, Oregon**

Factories: **Portland, Ore. • Vancouver, B. C., Canada**

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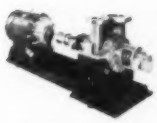
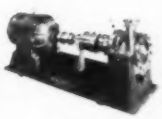
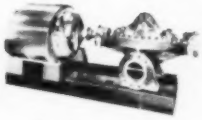
PUMPS FOR EVERY REFINERY SERVICE



Bingham Type CD "Double Volute" Double Suction vertically-split case pump for hot service.



Bingham Type CJ "Double Volute" Two-Stage Process Pump for high heads.



Bingham Type HSB "Double Volute" Double Suction Pump for high heads.

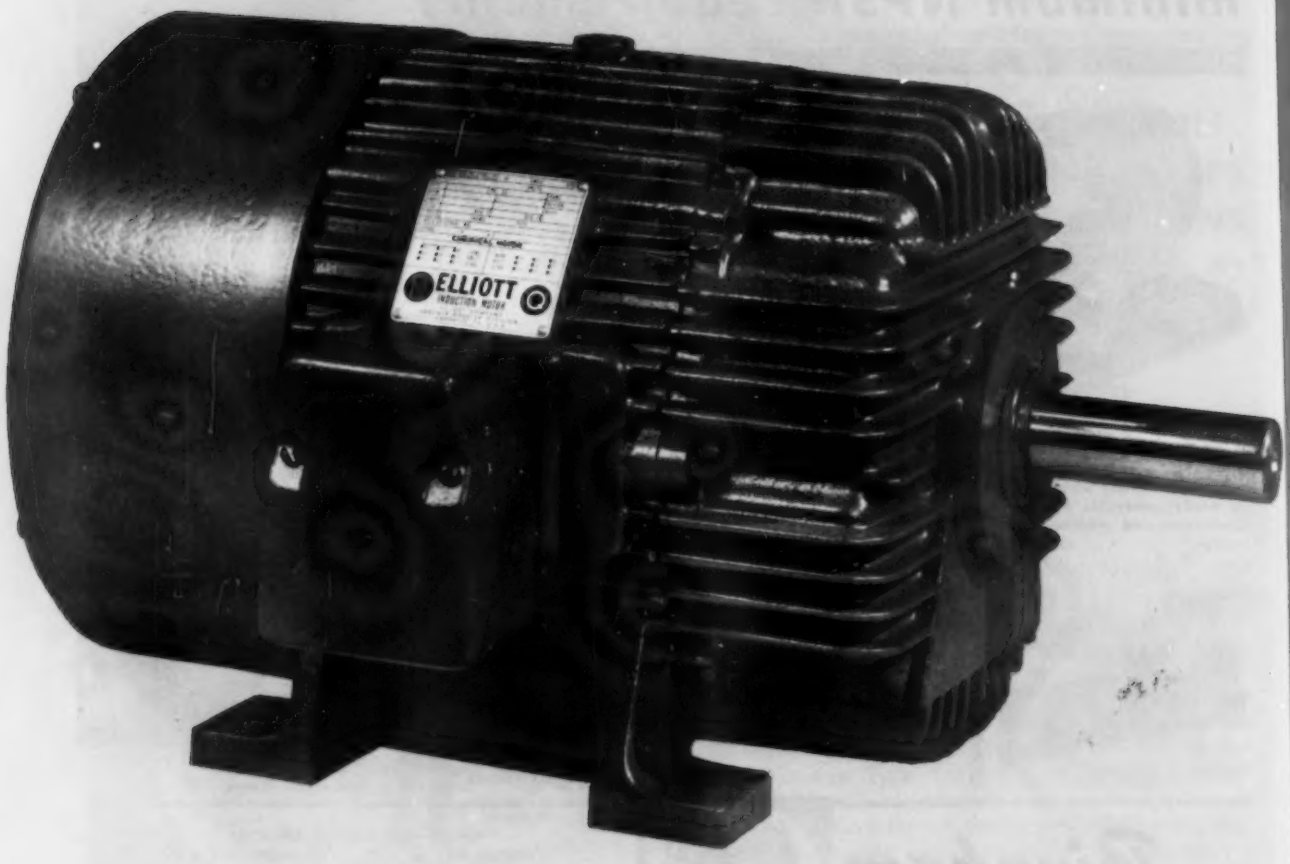
Bingham Type MSB Horizontally Split-Case "Double Volute" Multi-Stage Pump for high pressure hot or cold service.

Bingham Type KT Stuffing-boxless Pump for high suction pressures and cold service.

Bingham Type VCP Vertical Pump for low NPSH conditions, featuring bottom dismantling.

 (To obtain more data on advertised products see page 126)

Protected



ELLIOTT Company

Crocker-Wheeler Division • **JEANNETTE, PENNSYLVANIA**

Send for new bulletin PB 6000-8, describing the remarkable Elliott Sealedpower C-W Chemical Motors.

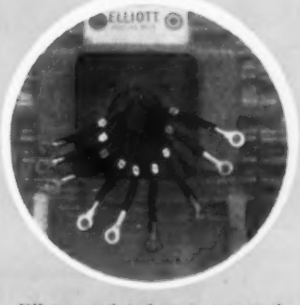
against corrosion

new ELLIOTT C-W sealedpower chemical motor

Thoroughly protected against corrosive vapors, gases and moisture, the new Elliott C-W totally-enclosed Chemical Motors are designed to serve dependably under conditions that would incapacitate other motors. Every vulnerable point has been sealed or armored. The frame, brackets, fan cowl and conduit box are corrosion-resistant cast iron. The external fan is made of either cast bronze or cast aluminum (choice depending upon service conditions), with a split hub, keyed to the shaft. The windings are given special chemical-resisting treatment with siliconized varnish, providing a tough surface that resists acids, alkalies and moisture. A rotating slinger on the motor shaft effectively prevents the entrance of moisture and foreign matter. Leads are sealed by tightly-packed grommets. Nameplate is Monel and external hardware is heavily plated.

SOME OF THE PROTECTIVE FEATURES OF ELLIOTT CHEMICAL MOTORS

Windings have special chemical-resisting insulation.



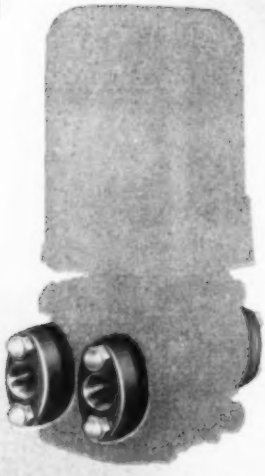
When conduit box is mounted, grommet is tightly compressed, sealing the point where leads pass through the frame.

A rotating slinger guards the shaft opening against the entrance of moisture or foreign matter.

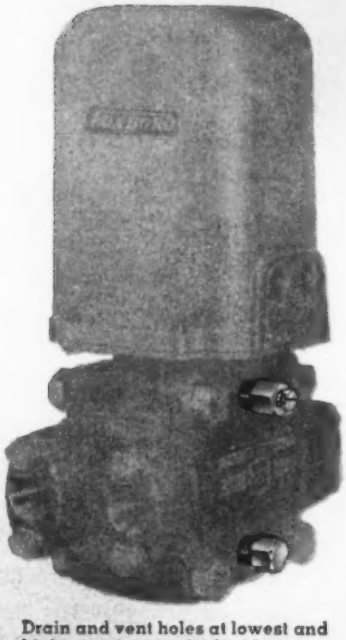
Cast bronze or aluminum external cooling fan is firmly attached to the shaft by both a key and bolted split hub. Safe against loosening and corrosion.

FOXBORO d/p CELL

unequaled –



Simplest installation — orifice flange tap connections at standard spacing, are provided at both ends.



Drain and vent holes at lowest and highest points on both sides.

Purged cover protects transmitter from weather, dust, and fumes.

Over 60,000 now in use!

No zero drift . . . positive overrange protection . . . high sustained accuracy even under the most punishing operating conditions. No wonder over 60,000 Foxboro d/p Cell Transmitters have been installed since they were introduced in 1948.

By introducing the modern concept of high speed flow measurement and control, these differential pressure transmitters have *revolutionized* many an industrial process. Bulletin 13-11A shows how — and portrays the benefits the d/p Cell Transmitter offers you. **Write The Foxboro Company, 918 Neponset Ave., Foxboro, Mass., U.S.A.**

FOXBORO

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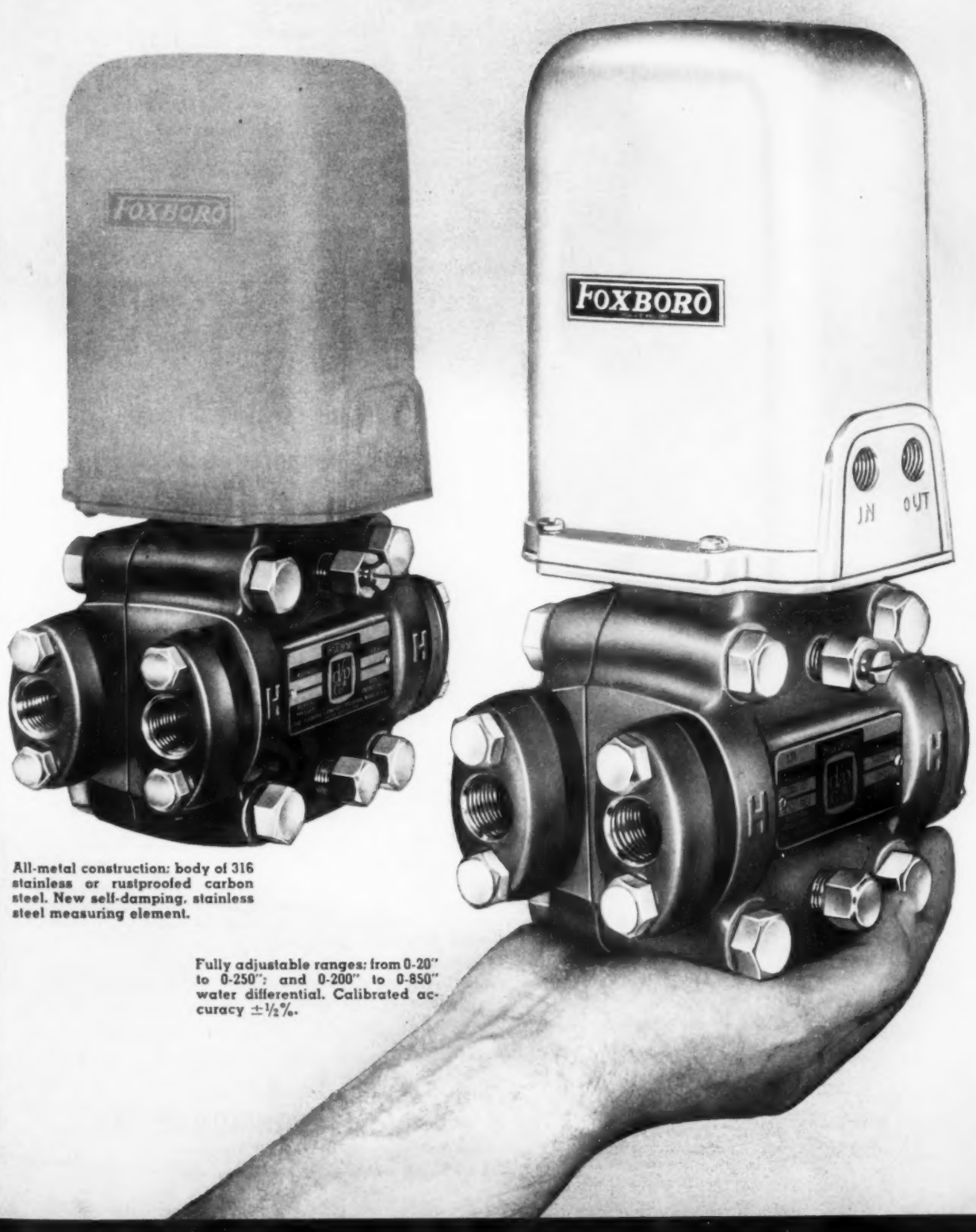
FIRST in Flow Measurement and Control

FLOW TRANSMITTERS...

in accuracy, stability and performance



All-metal construction: body of 316 stainless or rustproofed carbon steel. New self-damping, stainless steel measuring element.

Fully adjustable ranges: from 0-20" to 0-250"; and 0-200" to 0-850" water differential. Calibrated accuracy ±½%.

For piping systems that can't be anchored, use ZALLEA HINGED EXPANSION JOINTS

Piping systems like the one in this 63,750 bbl/day catalytic cracking unit, one of the world's largest, at Gulf Oil Corp. Girard Point Refinery, have to be entirely self supporting. The entire cracking unit . . . reactor, regenerator and all connecting lines . . . is suspended in a huge structural steel framework, counterweighted to keep the system in balance, and fitted with Zallea Hinged Expansion Joints to provide vital flexibility plus support for the reactor.

In the 150 ft. air supply line, all thermal movement of the piping is absorbed by angular displacement in three 42″ dia. Zallea Hinged Expansion Joints. Start-up air in this line is at 1000°F. Under operating conditions it is delivered at 250°F, 25 psig.

Two 50″ dia. Zallea Hinged Expansion Joints in the spent catalyst line carry fluidized cracking catalyst at 950°F, 13 psig.

Since this cracking unit first went on stream, these Zallea Expansion Joints have given completely trouble-free service.

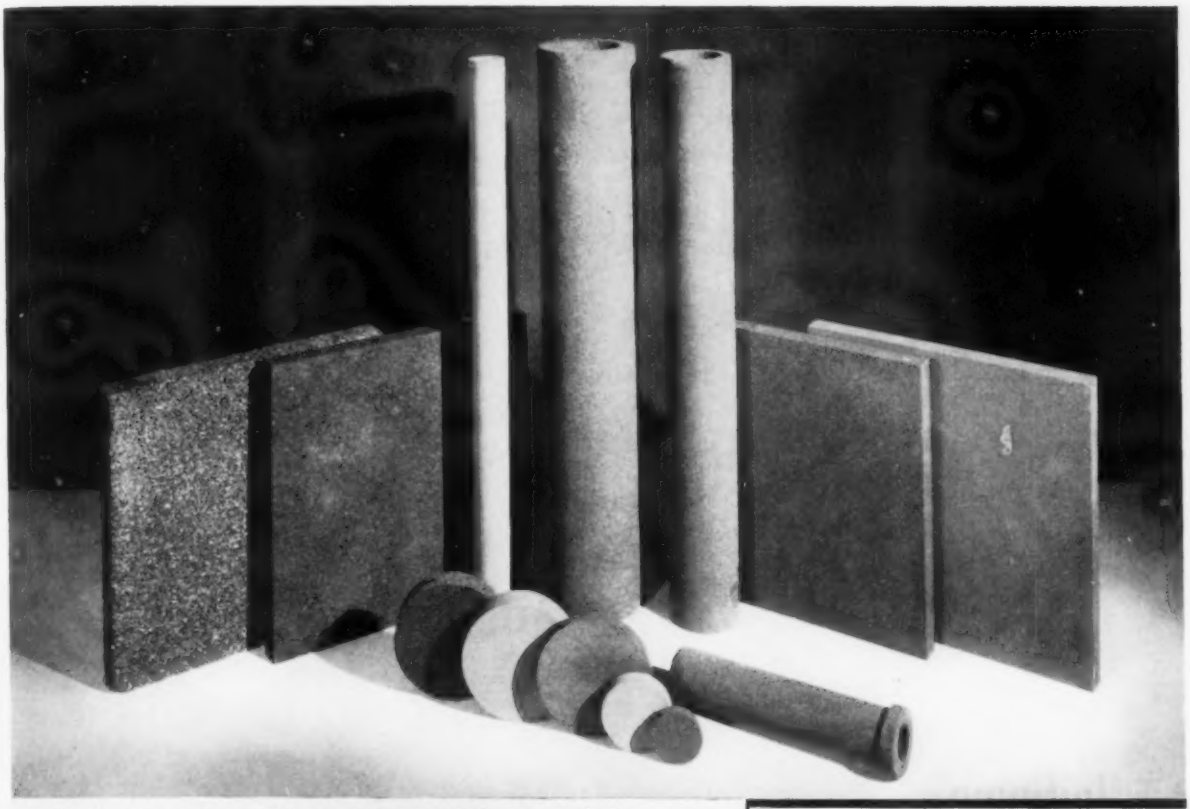
Process piping of any kind can be fully protected with one or more Zallea Expansion Joints. From the complete Zallea line you can select the expansion joint or combination of expansion joints best suited to your particular problems.

Get the complete story in our new 72-page manual. Write today, on your company letterhead, for your copy of Catalog 56. Zallea Brothers, 822 Locust Street, Wilmington 99, Delaware.

Zallea expansion joints

Zallea Brothers • Wilmington 99, Delaware

World's largest manufacturers of expansion joints



Norton ALUNDUM porous tubes and plates made by a controlled structure process. Available in a range of sizes and degrees of permeability for filtration, aeration and diffusion.

Leaders choose Norton porous media

Foremost filter manufacturers find ALUNDUM products pay off*

Such leading manufacturers of filter equipment as Proportioneers, Inc. of Providence, Rhode Island, use ALUNDUM porous tubes in their equipment. Made of tough aluminum oxide, these acid-resistant tubes can really take it — that's why they provide long, trouble-free service.

For Your Processing

Specify ALUNDUM porous media — tubes and plates — *engineered and prescribed* to give you better service, save your time and cut costs. Contact your local Norton Representative or write direct for descriptive literature to NORTON COMPANY, Refractories Division, 267 New Bond Street, Worcester 6, Massachusetts.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

ALUNDUM *seamless* porous tubes are ideal for diatomite filters producing clear, clean water for swimming pools, municipal water systems and industrial use.

NORTON
REFRACTORIES

Engineered... Rx ...Prescribed

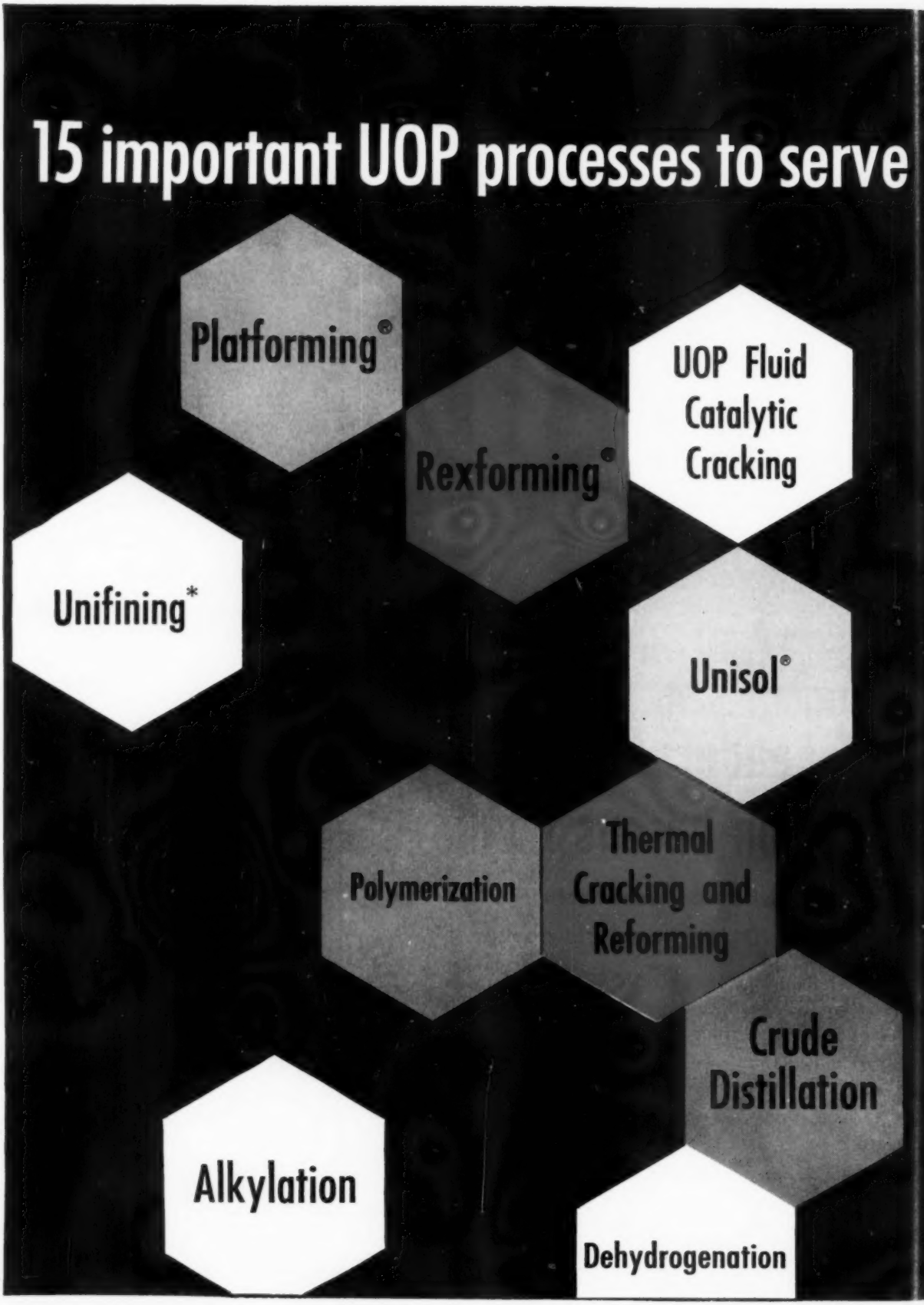
Making better products . . . to make your products better

NORTON PRODUCTS:
Refractories • Abrasives • Grinding Wheels • Grinding Machines

BEHR-MANNING DIVISION:
Coated Abrasives • Sharpening Stones • Behr-cat Tapes

 (To obtain more data on advertised products see page 126)

15 important UOP processes to serve



(To obtain more data on advertised products see page 126)

Visbreaking

the oil refining business

Udex®

Penex*

Wherever you go, the world over, you'll find these UOP processes helping refiners do a better job.

The names displayed here identify some of the most widely used and best known refining and petrochemical processes made available to the entire petroleum industry by Universal Oil Products Company.

But mere process names and techniques do not indicate the full measure of their importance to the industry. What really counts is the ability to adapt the right processes to each individual refiner's needs.

UOP is not just in the business of developing and licensing refining processes. That's only the beginning. The big part of our job is helping the individual refiner make use of our modern developments to better his operating and economic position by producing a larger volume of high quality products from every barrel of crude he processes.

That's why UOP refining and petrochemical processes are highly flexible in design, in through-put, in product, tailored to the individual refiner's needs. That's why UOP carefully analyzes the economics of any process in relation to individual product and market requirements.

For more than forty years UOP has followed the policy of making sure that its developments are applicable, economically and practically, to their user's needs. Whatever the processing needs Universal will continue to serve the oil refining business well.

UOP®

UNIVERSAL OIL PRODUCTS COMPANY

30 Algonquin Road, Des Plaines, Illinois, U.S.A.

More Than Forty Years Of Leadership In Petroleum Refining Technology

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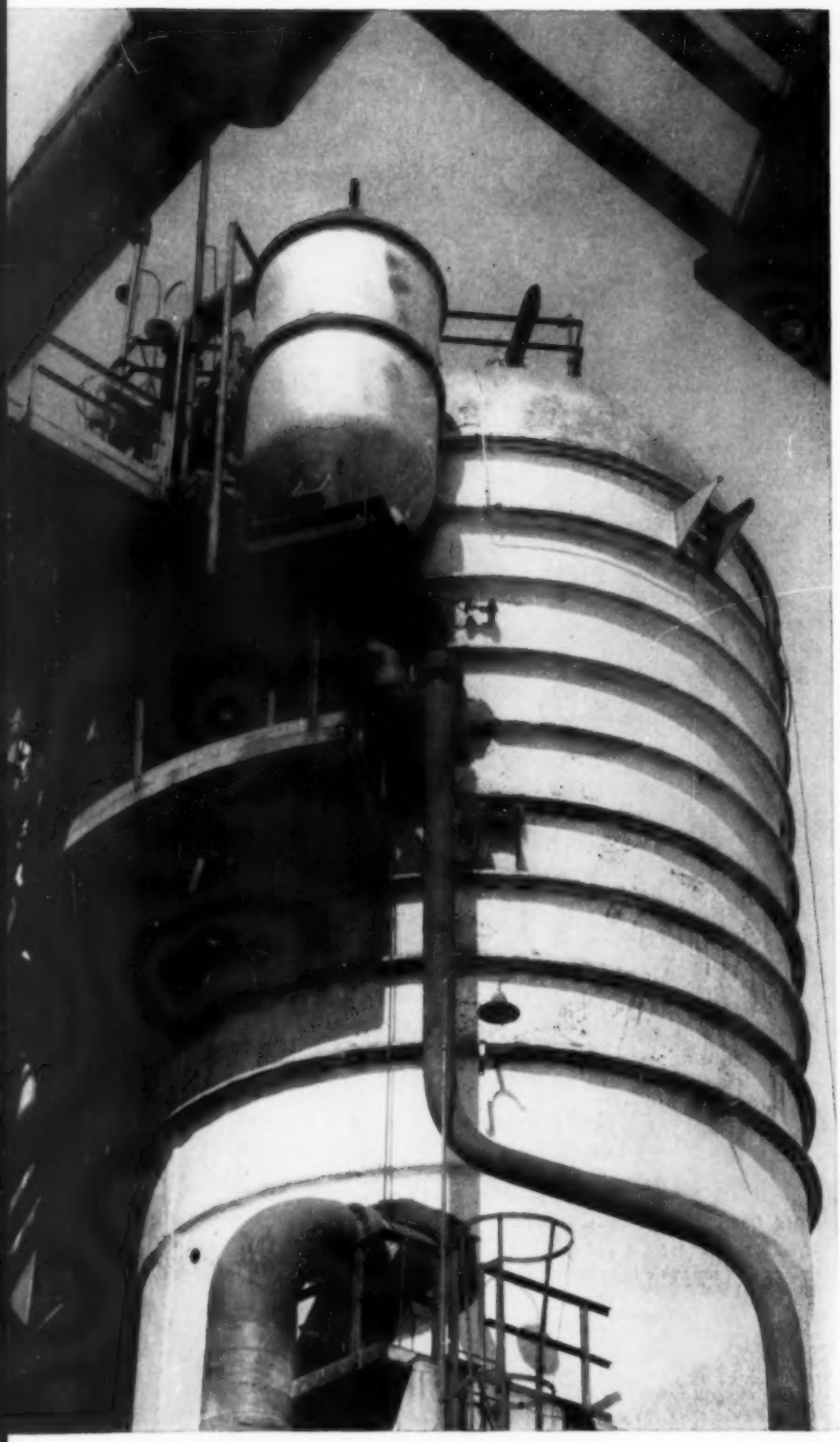
Low Pressure Coking

Catalytic Condensation

STAINLESS STEEL SOLVES



CORROSION PROBLEM

in 740° F. vacuum evaporator

AT SINCLAIR'S
MARCUS HOOK REFINERY

Sinclair Refining Company operates a light distillate refinery at Marcus Hook, Pa. Some of the products are gasolines, kerosenes, propane, xylene, toluene, paraxylene, Bunker C and Navy Special fuel.

Two vacuum evaporators take the reduced crude and remove from it gas oils (as overhead products) and asphalt (as bottom product), and the latter is upgraded into heavy fuel by visbreaking. The evaporators operate at about 740° F.

The carbon steel vessels were originally unlined, but inspection showed that they were failing rapidly. Essentially, this was high-temperature sulfur corrosion, coupled with severe erosion caused by the reduced crude entering under pressure into the vacuum.

The evaporators were promptly lined with type 410 Stainless Steel sheets in the flash sections, and, *in five years of service*, the sheets show little signs of wear. In fact, engineers expect the Stainless sheets to last at least another five years—more probably ten.

For refinery corrosion and erosion problems, think of Stainless Steel. For service-tested quality, specify *USS* Stainless Steel.

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
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7-59

UNITED STATES STEEL

DU PONT *Petroleum Chemicals* NEWS

Number 78 in a Series of Bulletins for the Petroleum Industry

AUGUST 1957

Three major projects insure still better TEL delivery, service

NEW ASSISTANT TO THE TECHNICAL MANAGER

ANTON O. MELBY is assistant to the Technical Manager of the Du Pont Petroleum Chemicals Division. His duties involve the coordination of both technical service and new product development.

He came to this post from the Du Pont Petroleum Laboratory where he was in charge of the gasoline additives division. Among the projects of this group was the development of Dimethyl Formamide (DMF) as a gasoline anti-icing agent. Prior to this he was supervisor of the Petroleum Laboratory group working on combustion and scavenging.

In connection with his work at the Laboratory, Mr. Melby published a number of technical papers on combustion reactions and the effect of additives. Among them are papers titled: "An Investigation of Pre-ignition in Engines," "The Effects of Fuel Additives on the Precombustion Reactions of n-Heptane."

Following three years of service in the Army during World War II, Mr. Melby earned a B.S. degree in chemical engineering at the University of Wisconsin. He then continued his studies, at the University of Michigan, receiving an M.S. degree there in 1949. He joined the Du Pont Petroleum Laboratory staff in 1950.

He is a member of the Society of Automotive Engineers and the Petroleum Division of the American Chemical Society.

Du Pont adds important facilities in first half of '57

The new TEL storage and delivery terminal at Beaumont, Texas, is the latest addition to the rapidly growing list of Du Pont facilities for serving the company's TEL customers.

Earlier this year the TEL tank-ship, *MV Petrochem*, which was commissioned two months ago, became another major addition to Du Pont's tetraethyl lead distribution setup. The Petroleum Chemicals Division's new TEL manufacturing plant has been completed at Antioch, California. It is the only TEL plant located in the important West Coast refining area.

THE RECENTLY COMPLETED Du Pont TEL terminal at Beaumont, Texas. It contains complete modern facilities for the storage and handling of TEL, and rapid dispatch of loaded tank cars.

The new Beaumont terminal, which represents an important delivery convenience for Gulf Coast refiners, will be supplied from the Du Pont TEL plant at the Chambers Works, Deepwater, N. J., by the tank-ship.

The terminal has ample storage capacity to meet the expanding TEL requirements of the Gulf Coast refineries. It contains complete TEL handling facilities. A rail siding on the property means that a number of TEL tank cars can be pre-loaded there and be ready for immediate dispatch to any refinery in the area. A dock and special unloading equipment for the new tank-ship are also important segments of the operation.

This means that the new Beaumont terminal is equipped to provide refiners with the same TEL availability and fast delivery service as Du Pont's manufacturing plants.

Unique ship

The *MV Petrochem* is a two-cargo vessel. Designed primarily to move bulk

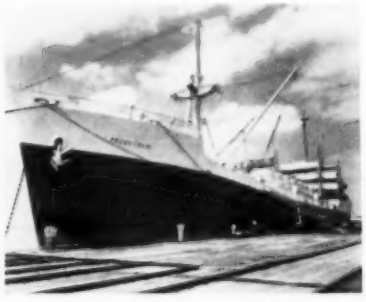
ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DUPONT *Petroleum Chemicals* NEWS

CONTINUED *Major Projects*

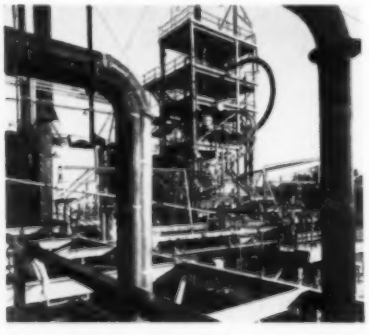
shipments of TEL south, she is equipped also for transporting ethyl chloride and ethylene dichloride on the northbound sailing.



THIS 6,000-TON SHIP, *MV Petrochem,* is the first overwater chemical carrier to transport TEL compound in bulk.

New West Coast Plant

DuPont's new TEL manufacturing plant at Antioch, California, was constructed to meet the needs of the fast-growing West Coast oil industry. The new plant makes possible fast, short-distance shipments of California-made TEL to all West Coast refineries.



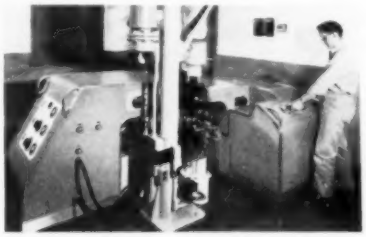
THIS NEW DuPont TEL plant in California incorporates the most modern, continuous process TEL manufacturing facilities in the world.

These three major expansions will increase even more the efficiency of the nationwide network of DuPont TEL facilities – which, as previously, includes also conveniently located rail sidings with loaded tank cars in 14 major refining areas across the country, plus the five Petroleum Chemicals Division regional laboratories and the twelve sales and service offices.

The many technical, marketing, research, safety, and operational services offered by DuPont . . . the most complete line of petroleum additives offered by any supplier . . . the new facilities—these together assure you of getting the most out of your additives program.

New facts about knock uncovered by spectrometric study at Du Pont Petroleum Laboratory

A versatile spectrometer geared to a single-cylinder engine is being used at the DuPont Petroleum Laboratory to study the reactions responsible for the cool, blue, and intense blue flames which are obtained in an engine combustion chamber as it is motored under increasingly severe operating conditions.



HERE IS the unique spectrometer used by the DuPont Petroleum Laboratory for studying the chemistry of knock and the fundamentals of combustion. The operator is shown adjusting the amplifier for recording. Part of the single-cylinder engine can be seen in the center of the picture.

As a result of these studies, spectral evidence has been found by the Laboratory indicating that these reactions progressively involve more extensive degradation and oxidation of the fuel. Hydrocarbon decomposition and formation of carbonyl compounds are involved in reactions emitting cool flames. And further oxidation of carbonyl compounds is especially important in reactions giving blue flames.

Free radical reactions

The free radical reactions occurring under intense blue flame conditions easily lead to auto-ignition and knock. But tetraethyl lead apparently interferes with this series of reactions by slowing down carbonyl decomposition reactions under blue flame conditions, possibly by deactivating free radical intermediates.

A detailed account of this study was recently published. When writing for a copy, refer to the title, "Spectrometric Investigations of n-Heptane Preflame Reactions in a Motored Engine."

New book gives detailed information about Du Pont Fuel Oil Additive No. 2

DuPont FOA-2 is probably the most versatile of all fuel oil additives. Its wide range of applications includes home heating, residual, and diesel fuels of all grades . . . for railroad, marine, truck, tractor and stationary engines. It has also been found to be highly effective for cleaning heat exchangers and sludge-laden tanks.

To help refiners benefit fully from FOA-2 in all these applications, we have just published a comprehensive 24-page book about it. All the basic information you will need is included—composition and properties, use concentrations, handling and additive methods, performance testing, and a discussion of the quality of FOA-2 in all its applications. The book is fully illustrated with photographs, charts and diagrams; a copy is yours for the asking. Just write our nearest sales office.

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Pittsburgh 22–1 Gateway Center ATlantic 1-2933
San Francisco 4–111 Sutter St. EXbrook 2-6230
Seattle 3–4003 Aurora Ave. MElrose 6977
Tulsa 1–1811 So. Baltimore Ave. LUther 5-5578
In Canada–DuPont Company of Canada (1956) Limited, Petroleum Chemicals, 85 Eglinton Ave. East, **Toronto 12**–Ontario HUdson 1-6461
In Other Countries–Organic Chemicals Department, Export Division, 7447 Nemours Bldg., Wilmington 98, Del., OLympia 4-5121, Ext. 2962.

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Better Things for Better Living
. . . through Chemistry

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

Printed in U. S. A.

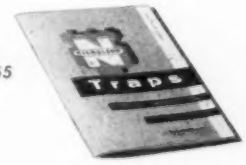
don't waste steam

Nicholson steam traps have a powerful, intermittent valve action which closes the valve *completely*. Hardened stainless steel valve and seat are lapped and mated—there's no steam waste, no dribbling. And that's not all. With just one thermostatically-operated moving part, there's nothing to get out of order, nothing to go wrong. Nicholson means continuous and low-cost operation of your steam-using equipment . . . no downtime from trap failure.

- **high air-venting capacity . . . for faster warmup of equipment.**
- **small and lightweight . . . easy to pipe and support.**
- **each unit steam-tested before shipment.**

So, to get a trap that avoids waste, saves money, specify Nicholson. W. H. NICHOLSON AND COMPANY, 14 OREGON ST., WILKES-BARRE, PA. *Sales and Engineering offices in 98 principal cities.*

Write for Bulletin 1055



NICHOLSON
of Wilkes-Barre

(To obtain more data on advertised products see page 126)

you can meet any lubrication specification if you

BLEND WITH ENJAY PARANOX®

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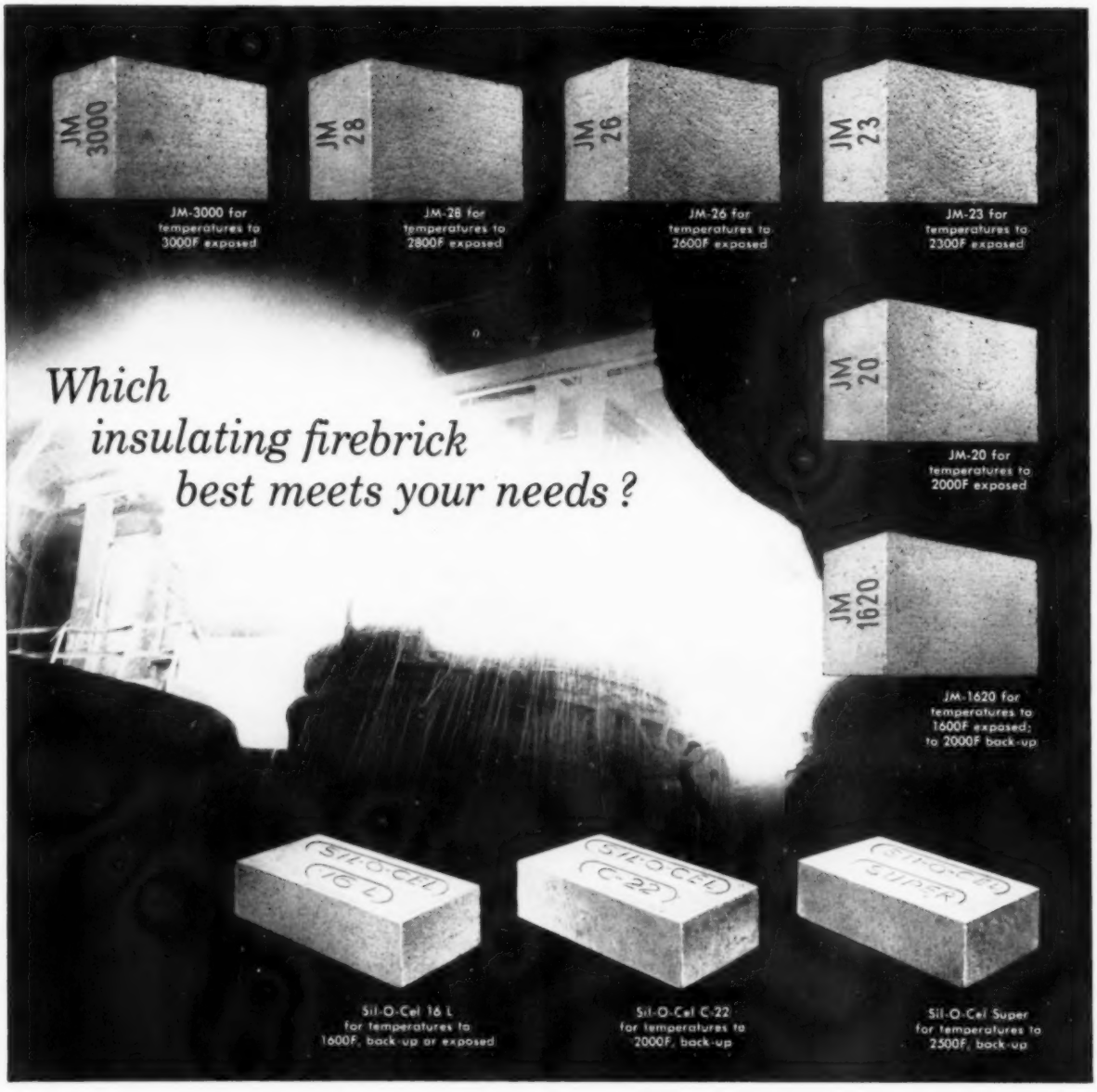
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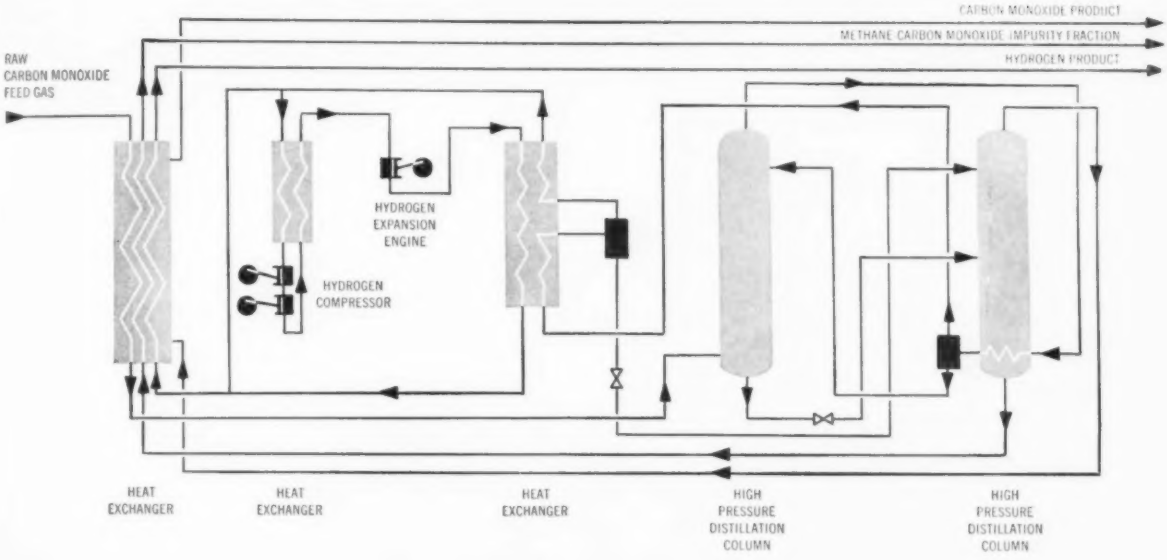

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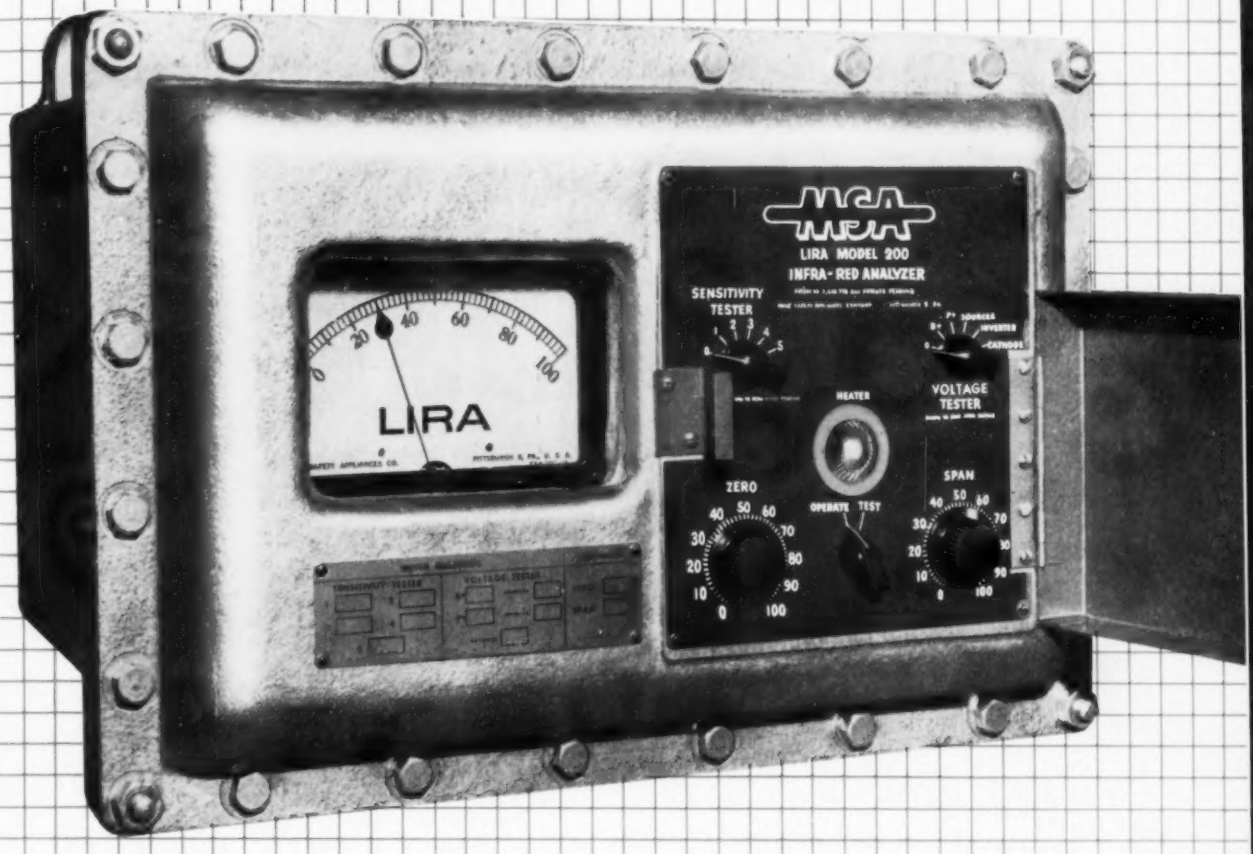

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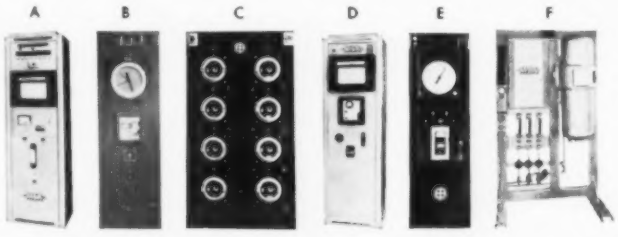

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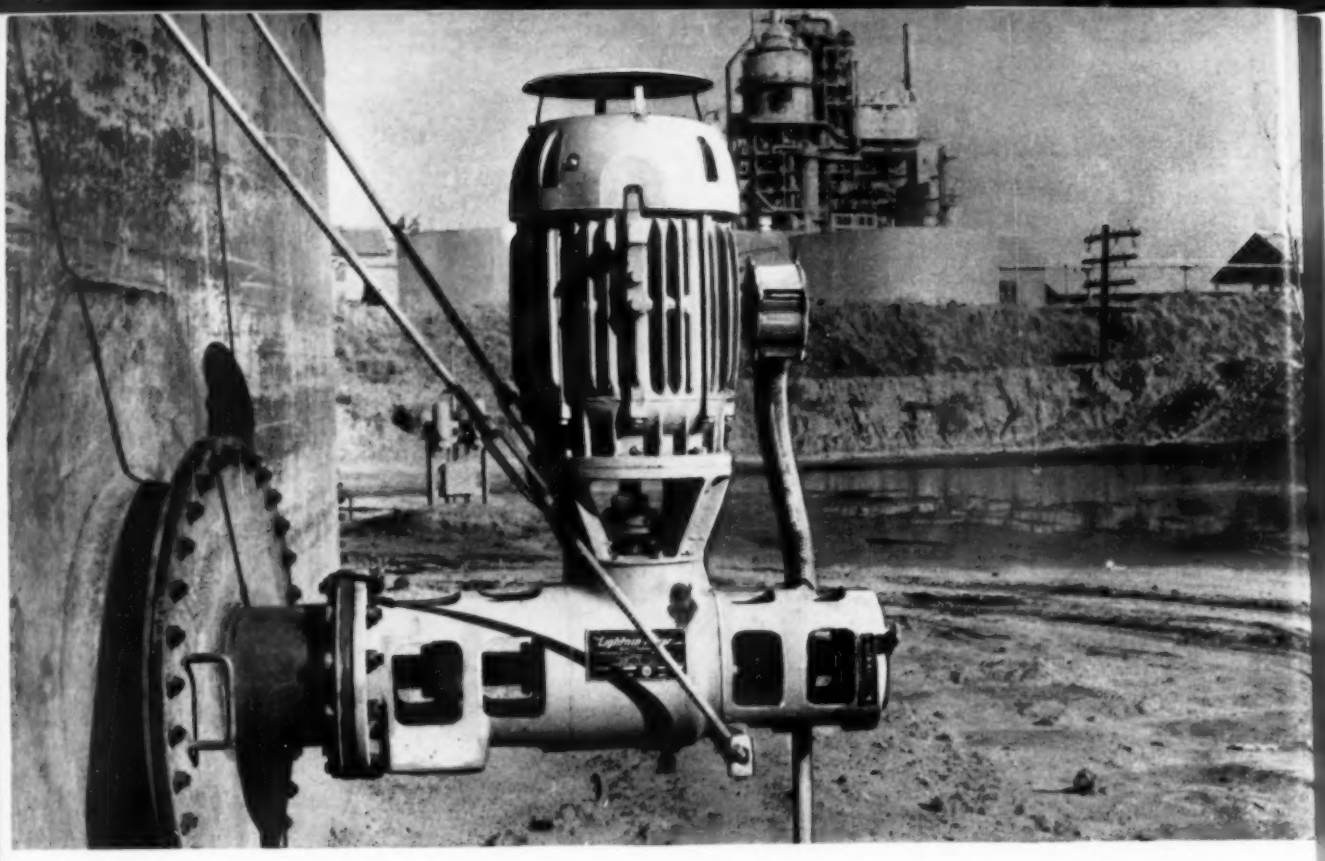

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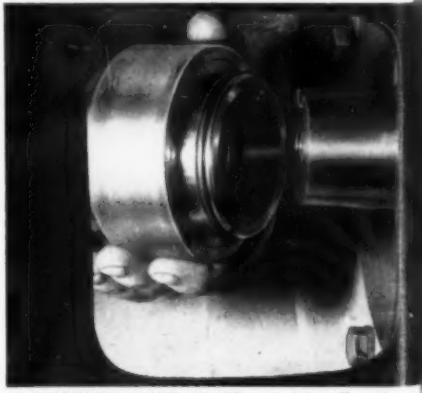

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By MERK HOBSON and JAMES H. WEBER
University of Nebraska

OF HIGH importance to the solution of many processing problems are accurate data on latent heats of vaporization and on enthalpy and entropy for pure hydrocarbons and their mixtures.

The design engineer must frequently estimate latent heats of vaporization from a minimum of information. He must resort to generalized procedures consistent with the data available to him.

Also very useful to the process-design engineer are the derived thermodynamic properties of enthalpy and entropy. For example, in calculations as varied as the determination of a compressor work load or the determination of the heat to be supplied in the reboiler of a distillation column, the design man makes use of these data.

"These articles compare the methods available for the determination of thermodynamic data required for design work," authors Hobson and Weber pointed out to PETROLEUM PROCESSING.

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This series of four articles will help fill those needs. The subjects of each article are:

Part I—Latent heats of vaporization for pure hydrocarbons.

Part II—Latent heats of vaporization for hydrocarbon mixtures.

Part III—Enthalpy and entropy data for pure hydrocarbons.

Part IV—Enthalpy and entropy data for hydrocarbon mixtures.

Part I begins on the next page

Meet the authors of this series

Dr. Hobson

Dr. Weber

The authors are well-grounded in this field. Merk Hobson is now assistant dean, College of Engineering & Architecture, University of Nebraska. He received his B.S. in 1943 from the University of Wisconsin and Ph.D. in 1951 from Northwestern.

Dr. Hobson has been with Esso Standard Oil Co. (La.) and the Pure Oil Co. during his career. He is a member of the American Chemical Society, American Institute of Chemical Engineers, and American Society for Engineering Education.

James H. Weber, associate professor of chemical engineering at Nebraska, obtained his chemical engineering education at the University of Pittsburgh: a B.S. in 1941, M.S. in 1947, and Ph.D. in 1948. He is a member of the ACS, AIChE, ASEE, and Sigma Xi.

Both are previous contributors to PETROLEUM PROCESSING. They jointly authored "For Gaseous Mixtures . . . Predicting Volumetric Behavior," August, 1955, pp 1143-5. Prior to that, Dr. Weber authored "Temperature-Enthalpy Data for Ethylbenzene," April, 1954, pp 545-7, and "Predict Isothermal Enthalpy Changes," Jan, 1955, pp 83-85.

Part I—Latent Heats of Vaporization for Pure Hydrocarbons

MOST of the methods that have been advocated for determining the latent heats of vaporization of a pure compound have their origin in the familiar Clapeyron equation,

$$\frac{dP}{dT} = \frac{\Delta H_v}{T(V_g - V_l)} \qquad (1)$$

which offers an exact thermodynamic relationship between temperature and pressure in a two-phase system under equilibrium conditions.

The precision of latent heats calculated by means of Equation (1) is limited only by the accuracy of the vapor pressure and volumetric measurements that are available for the substance under consideration. In most instances, precise data of this type are not available; so the generalized solutions for this relationship are of considerable practical importance to the design engineer.

A number of valuable methods are available for estimating the latent heats of vaporization of pure substances under various conditions from a known value of the latent heat at some specific condition, or from known values for a reference substance. The methods of Othmer [19], Gordon [6], and Watson [28] may be used for this purpose, and these have been adequately discussed elsewhere[4].

The present discussion is primarily concerned with the procedures that have been developed for a direct solution of Equation (1) from a minimum amount of data, and suggests an improved generalized method based on recent developments in the theorem of corresponding states.

Direct application of Equation (1) for determination of the latent heat of vaporization requires the slope of the vapor pressure relationship and the difference in volumes of the conjugate phases at any given point along the vapor liquid two-phase boundary.

If the constants of a vapor pressure equation are available or may be determined from experimental measurements for the specific substance, the slope of the vapor pressure curve can be conveniently determined by analytical differentiation. Much of the vapor pressure data on organic compounds have been expressed in the form of an equation of the Antoine type,

$$\log P = A - \frac{B}{t+c} \qquad (2)$$

The Gamson and Watson [5] vapor pressure relationship in the form

$$\log P_r = -\frac{A''(1-T_r)}{T_r} - e^{-20(T_r-b)^2} \qquad (3)$$

has also been frequently used for this purpose. Upon differentiation, Equation (2) becomes:

$$\frac{dP}{dT} = \frac{2.303\,BP}{(t+c)^2} \qquad (4)$$

and equation (3):

$$\frac{dP_r}{dT_r} = 2.303P_r\left[\frac{A''}{T_r^2} + 40(T_r-b)e^{-20(T_r-b)^2}\right] \qquad (5)$$

Both of these equations contain vapor pressure constants applicable to the specific compound under consideration and cannot be regarded as completely general expressions for the dP/dT term.

Experimental vapor pressure measurements are more numerous than the volumetric data required for the evaluation of the volume difference term, and the latter is usually the limiting factor in the direct application of Equation (1). Under these conditions, a solution to Equation (1) requires the use of a generalized equation of state or the simplifying assumptions of negligible volume in the liquid phase and ideal behavior in the vapor phase, which lead to the Clausius-Clapeyron relationship,

$$\frac{dP}{dT} = \frac{P\,\Delta H_v}{RT^2} \qquad (6)$$

Equation (6), however, is not satisfactory for pressures much above atmospheric.

Haggenmacher [7] has developed a general solution for the volume difference term based upon the fact that the loci of saturated liquid and vapor volumes on *P-V-T* coordinates form a skewed curve that is quadratic in V. Because a single variable is sufficient to define the equilibrium state for pure substances (i.e. the state is univariant), this quadratic function lies in a two-dimensional plane and a general solution for the volume at any point on the curve can be expressed as

$$V = \frac{V_g + V_l}{2} \pm \frac{V_g - V_l}{2} \qquad (7)$$

Haggenmacher developed an equation of state, quadratic with respect to V, in the form

$$P = \frac{RT}{(V+B')} - \frac{A'}{T(V+B')^2} \qquad (8)$$

which represents the volumetric data for saturated liquids and vapors with satisfactory precision. By solving Equation (8) explicitly for V,

$$V = \frac{RT}{2P} - B' \pm \sqrt{\left(\frac{RT}{2P}\right)^2 - \frac{A'}{PT}} \qquad (9)$$

and combining with Equation (7), Haggenmacher then obtained a relatively simple expression for the difference between the volumes of the saturated phases,

$$V_g - V_l = \sqrt{\left(\frac{RT}{P}\right)^2 - 4\frac{A'}{PT}} \qquad (10)$$

Because the difference in volumes is zero at the critical point, the constant, A', may be determined quite readily

Nomenclature

P=absolute pressure, psia
T=absolute temperature, °R.
t=temperature, °F or °C
V=molal volume, cu ft/lb mole
R=gas law constant, 1.987 Btu/lb mole —°R or 10.73 psia—cu ft/lb mole —°R
ΔH_v=molal latent heat of vaporization, Btu/lb mole
Z=compressibility factor, PV/RT
A, B, c=constants in the Antoine type vapor pressure relationship, Equation (2)
A'',b=constants in the Gamson and Watson [5] vapor pressure relationship, Equation (3)
A', B'=constants in the Haggenmacher [7] equation of state
A''', B'''= constants in the vapor pressure relationship, Equation (17)
A'''', B''''=constants in the vapor pressure relationship, Equation (19)

Subscripts

g refers to the vapor phase
l refers to the liquid phase
c refers to a property at the critical point
r refers to a reduced property
b refers to the normal boiling point

from the critical properties of the compound; and the general expression for ΔV becomes,

$$V_g - V_l = \frac{RT}{P}\sqrt{1-\frac{PT_r^3}{P_cT_r^3}} = \frac{RT}{P}\sqrt{1-\frac{P_r}{T_r^3}} \quad (11)$$

Equation (11) may be used to estimate the difference in molal volumes at any point on the saturation curve provided that the critical properties are known. Although it is based upon a relatively simple two-constant equation of state, Equation (11) provides excellent results at lower pressures. The accuracy of the equation decreases as the pressure increases, however, and above 0.4 P_r, the errors may become appreciable.

By combining Equation (4) for the slope of the vapor pressure curve with Equation (11) for the volume difference, Haggenmacher [8] obtained a direct relationship for the latent heat of vaporization,

$$\Delta H_v = \frac{2.303\,RBT^2}{(t+c)^2}\sqrt{1-\frac{P_r}{T_r^3}} \quad (12)$$

O'Hara and Fahien [17] have used this expression to calculate the latent heats of vaporization for some 80 compounds over the range between the triple and critical points. If the vapor pressure constants have been determined accurately, Equation (12) may be used with excellent precision up to pressures approximately one-half of the critical pressure.

The compressibility factor equation of state,

$$PV = ZRT \quad (13)$$

has been most frequently used for estimating the volume difference in Equation (1). If the volume of both saturated phases are expressed in the form of Equation (13), the difference becomes,

$$V_g - V_l = \frac{RT}{P}(Z_g - Z_l) \quad (14)$$

Maxwell [14] and later Meissner [15] proposed solutions for the Clapeyron equation based on a generalized correlation between the difference in compressibility factors and the reduced variables. Although these and other correlations [1] involving the liquid phase compressibility factor have appeared in the literature, the compressibility factor has not been accepted as a satisfactory representation for liquid volumetric data until recently.

The experimental evidence has shown conclusively that reduced pressure is not a unique function of reduced temperature, and although the states along the two-phase boundary are univariant, two reduced variables have been used to correlate the compressibility factors of saturated fluids.

Recent advances in the theorem of corresponding states have served to clarify this anomaly. Reidel [23] has proposed a generalized reduced vapor pressure relationship based on an additional variable that is characteristic of the substance rather than the state. Riedel used αc, the slope of the logarithmic vapor pressure curve at the critical point for this purpose. Lydersen, Greenkorn, and Hougen [12], and Hobson and Weber [9] have shown that the critical compressibility factor represents an equally satisfactory characterization for the substance.

By considering Z_c as an independent variable, it is possible to obtain a unique saturation curve for the compressibility factors of both liquids and vapors having the same critical compressibility factor. This unique saturation curve, or rather the series of saturation curves at various values of Z_c, may be expressed as a function of reduced pressure only. The difference between the compressibility factors of the saturated phases, therefore, is also a unique function of reduced pressure.

Hougen, Watson, and Ragatz [10] have published values of $(Z_g - Z_l)$ in the revised edition of "Chemical Process Principles," Part 1, without discussing the theoretical implication of these data. It was suggested that the difference term is essentially independent of the variable Z_c.

For comparative purposes, the values of $(Z_g - Z_l)$ determined from the data of Hobson and Weber [9] are presented in Table 1 for various critical compressibility factors. Note that the variations of the difference term with Z_c are small, although they are significant when compared at the extreme values of Z_c. Because the majority of all compounds have critical compressibility factors between 0.29 and 0.25, the effect of Z_c may usually be neglected.

The apparent lack of sensitivity with respect to the critical compressibility factor is caused by a combination of the relatively small magnitude of the compressibility factor for liquids and the minor variations in the vapor phase compressibility factors at the lower reduced pressures. The effect of Z_c becomes more pronounced as the pressure approaches the critical point.

As a result of these developments, the term $(Z_g - Z_l)$ may be estimated with greater precision using a single independent variable, reduced pressure, than has been possible in the past using two independent reduced variables. Equation (8) may be applied with reasonable accuracy to reduced pressures approaching unity and represents the most satisfactory generalized method currently available for estimating the volume difference over the entire vapor pressure relationship.

Hougen, Watson, and Ragatz [10] recommend a combination of the differential form of Equation (3) and Equation (14) for solution of the Clapeyron equation,

$$\Delta H_v = 2.303(Z_g - Z_l)RT_r\left[A'' + 40T_r^2(T_r - b)e^{-20(T_r-b)^2}\right] \quad (15)$$

At low values of b and high values of T_r, the equation simplifies to

$$\Delta H_v = 2.303\,RT_rA''(Z_g - Z_l) \quad (16)$$

Both of these expressions, as does Equation (12), involve vapor pressure constants, and the design engineer may frequently meet situations where a more general method would be more desirable. The Meissner correlation previously mentioned [15] is of this type. Meissner considered the equation

$$\log P = \frac{A'''}{T} + B''' \quad (17)$$

as a suitable representation for vapor pressure data and combined the differential form of Equation (17) with Equations (1) and (14) to yield a generalized expression involving the latent heat of vaporization,

$$\ln P_r = \frac{\Delta H_v}{RT_r(Z_g - Z_l)}\left(1 - \frac{1}{T_r}\right) \quad (18)$$

Table 1—Values of $(Z_g - Z_l)$ for various reduced pressures and critical compressibility factors [9]

P_r	Z_c=0.290	Z_c=0.275	Z_c=0.220
0.04	0.940	0.934	0.917
0.07	0.908	0.904	0.878
0.10	0.881	0.877	0.845
0.20	0.805	0.800	0.762
0.30	0.740	0.735	0.700
0.40	0.680	0.669	0.637
0.50	0.610	0.602	0.574
0.60	0.544	0.536	0.509
0.70	0.473	0.466	0.441
0.80	0.390	0.386	0.369
0.90	0.287	0.281	0.268
0.95	0.205	0.203	0.181
1.00	0.0	0.0	0.0

The general solution to Equation (18) was expressed graphically by plotting $\Delta H/T_c$ as a function of reduced temperature and reduced pressure. The principal advantage of the method lies in the fact that it does not involve arbitrary vapor pressure constants.

Actually, Meissner's equation is based upon the linearity of a reduced form of Equation (17):

$$\log P_r = \frac{A''''}{T_r} + B'''' \qquad (19)$$

and not upon the validity of equation (17) in representing vapor pressure data, as might be supposed. The linear property of Equation (19) has long been used as a means for extrapolating vapor pressure measurements and is generally recognized as a reasonable assumption. From the definitions of the reduced properties and from the calculus, it can readily be shown that,

$$\frac{dP}{dT} = -\frac{P d\ln P}{T^2 d(1/T)} = -\frac{2.303\, PT_c d(\log P_r)}{T^2 d(1/T_r)} \qquad (20)$$

If Equations (20) and (14) are combined with Equation (1), the result is:

$$\frac{d(\log P_r)}{d(1/T_r)} = -\frac{\Delta H_v}{2.303\, R\, T_c\, (Z_g - Z_l)} \qquad (21)$$

The left side of this relationship can be obtained by differentiation of Equation (19),

$$\frac{d(\log P_r)}{d(1/T_r)} = -A'''' \qquad (22)$$

and solving for the latent heat of vaporization,

$$\Delta H_v = (2.303)(R)(A'''')(T_c)(Z_g - Z_l) \qquad (23)$$

Equation (23) contains the slope, A'''', of the log P_r vs. $1/T_r$ relationship, but if the relationship is linear, the slope may be determined from any two points on the vapor pressure curve. The critical point and the point at which the latent heat value is to be determined are usually most convenient for this purpose.

Under these conditions, the slope becomes,

$$-A'''' = \frac{\log P_r}{(1 - 1/T_r)} \qquad (24)$$

When this value of A'''' is introduced in Equation (23), the result is exactly the same as that obtained by Meissner. For calculation purposes, however, it is more convenient to rearrange the form to

$$\Delta H_v = 4.575(\log 1/P_r)\frac{T_c T}{T_c - T}(Z_g - Z_l) \qquad (25$$

Table 2—Values of $\phi(P_r)$ for use with Equation (26)

$$\phi(P_r) = -R\,(\ln P_r)\,(Z_g - Z_l)$$

P_r	$\phi(P_r)$ Z_c=0.290	$\phi(P_r)$ 0.275*	$\phi(P_r)$ 0.220
0.01	—	8.995	—
0.02	—	7.524	—
0.04	—	5.974	—
0.06	—	5.087	—
0.08	—	4.472	—
0.10	4.031	4.012	3.866
0.20	2.754	2.558	2.437
0.30	1.770	1.758	1.675
0.40	1.238	1.218	1.160
0.50	0.840	0.829	0.791
0.60	0.552	0.544	0.517
0.70	0.335	0.330	0.312
0.80	0.173	0.171	0.164
0.90	0.0601	0.0588	0.0561
0.95	0.0209	0.0207	0.0184
1.00	0.0	0.0	0.0

*May be used as average values if Z_c is unknown.

Table 3—Error analysis for $(V_g - V_l)$ determinations

Compound	No. of datum	P_r range	Equation (14) Avg.	Equation (14) Max.	Equation (11) Avg.	Equation (11) Max.	Lit. ref.
Ammonia	10	0.0034-0.188	1.35	2.2	0.85	1.14	2
n-Butane	7	0.055-0.545	0.57	1.88	2.65	3.66	20
1-Butene	10	0.032-0.866	1.38	2.01	5.56	11.24	18
Carbon dioxide	9	0.003-0.903	0.75	2.27	4.52	13.40	22
Ethane	11	0.0004-0.891	1.30	2.16	7.92	46.9	3
n-Heptane	8	0.038-0.831	0.65	1.67	1.50	5.48	26
Water	9	0.031-0.967	3.68	5.80	3.49	18.10	11
Sulfur dioxide	11	0.0003-0.864	1.072	3.46	2.19	7.09	24
Average for all compounds	75	———	1.58	—	3.59	—	—

Table 4—Comparison of generalized methods for estimating the latent heats of vaporization of pure compounds

Compound	Pressure range, psia	No. of datum	Absolute errors, % Eq. (26)	Eq. (16)	Eq. (18)	Lit. ref.
Ammonia	18-310	4	1.46	1.78	7.96	2
1-3 Butadiene	2-210	4	2.24	16.72	8.25	16
n-Butane	30-300	4	2.20	4.87	3.96	20
Carbon dioxide	110-970	5	1.72	3.78	0.77	22
Freon 12	18-220	4	2.93	—	0.96	21
Ethane	24-630	4	1.31	2.74	3.92	3
Ethyl chloride	16-60	3	3.90	3.35	—	1
Ethylene	100-660	3	6.23	5.47	19.12	29
Methane	32-630	4	3.09	7.95	4.04	13
Methyl amine	10-100	3	5.54	4.39	—	22
Methyl chloride	15-280	4	3.43	3.68	4.69	27
Propane	16-575	7	1.25	3.05	1.78	25
Sulfur dioxide	10-990	5	6.58	10.54	5.45	24
Water	100-3100	9	5.07	—	3.68	11
Average absolute error, %			3.33(63)	5.67(50)	4.72(57)	—

Equation (25) represents a general method for determining the latent heat of vaporization of pure compounds at any known point along the vapor pressure curve providing the critical properties are available. It is based upon the assumption that the logarithm of reduced pressure is a linear function of the reciprocal of reduced temperature. The recent advances in the theorem of corresponding states, however, makes it possible to apply it with greater simplicity and accuracy than has been possible in the past. Because the difference in the compressibility factors of the conjugate phases may be expressed as a function of reduced pressure only, Equation (25) simplifies to

$$\Delta H_v = \left[\frac{T_c T}{T_c - T}\right]\phi(P_r) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (26)$$

The values of the function are listed in Table 2.

If the relationship between P and T is not known at the pressure in question, an analogous expression might be derived using the critical properties and the normal boiling point to evaluate the slope. Under these conditions,

$$A = \frac{-(\ln P_c)}{\left(\frac{T_b - T_c}{T_c}\right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (27)$$

where P_c is expressed in atmospheres. The expression for latent heat then becomes,

$$\Delta H_v = R(\ln P_c)\left[\frac{T_c T_b}{T_c - T_b}\right](Z_g - Z_l) \quad \ldots\ldots\ldots \quad (28)$$

where the $(Z_g - Z_l)$ term can be obtained from Table 1. In principle, at least, both equations should produce the same results. Equation (26) is preferable, however, because the slope is evaluated over a smaller range of vapor pressures compensating in part for deviations from linearity in the vapor pressure relationship, Equation (19).

As an initial step in comparing the accuracy of the methods that have been discussed, the values of $(V_g - V_l)$ estimated by both Equations (11) and (14) were compared with the experimental data for eight compounds.

The results of this comparison are presented in Table 3. The data for six of these compounds include reduced pressures above 0.8. At reduced pressures below 0.4, the Haggenmacher relationship proved to be as good or better than the compressibility factor equation. At higher reduced pressures, however, the latter method proved to be considerably more reliable. The maximum errors reported for the Haggenmacher equation, (11), correspond to the highest reduced pressure in all cases. This was not necessarily true for the compressibility factor method. In general, these comparisons indicated a greater overall consistency using the compressibility factor equation, although the increased accuracy was particularly significant at higher pressures.

The comparative accuracies of the various equations involving specific vapor pressure constants, Equations (12) and (15), were not considered. Because they involved more data specific to the compound than do the generalized methods, they may be assumed to provide a more accurate estimate of the latent heat of vaporization.

The experimental latent heats of vaporization for some 14 different compounds were compared with values estimated by the generalized methods of Equations (16), (18), and (26). These comparisons are summarized in Table 4. In principle, Equation (26) is essentially the same as Meissner's method, Equation (16). They are both based upon an assumption that the logarithmic reduced pressure term is a linear function of the reciprocal of reduced temperature. Equation (26), however, includes the simplifications made possible by correlation of the compressibility factor difference as a function of reduced pressure only, while the Meissner method expressed this difference as a function of both reduced pressure and reduced temperature. The third method used in the comparison, Equation (18), is based upon the same evaluation of the compressibility factor difference as Equation (26), but assumes a generalized vapor pressure relationship derived from Equation (3).

In general, Equation (26) proved to be the most consistent method, with an average error for a wide range of reduced pressures of approximately 3.5%. The estimates obtained from the graphical solution for Equation (16) indicated an average error in the order of 5.5%, which agrees quite well with Meissner's error analysis. For certain compounds, Equation (18) provided excellent results, but on an overall basis, the results tended to be more erratic than the other methods. In addition, Equation (18) requires a knowledge of the critical compressibility factor for the determination of the constant A'' (12).

Although these comparisons are by no means exhaustive, it appears that Equation (26) provides an improved generalized solution for the Clapeyron equation based upon a knowledge of the critical properties of the material and the pressure-temperature values at the point in question. It should be emphasized, however, that more exact solutions for the Clapeyron relationship are possible providing that reliable vapor pressures and saturated volumes for both phases are known.

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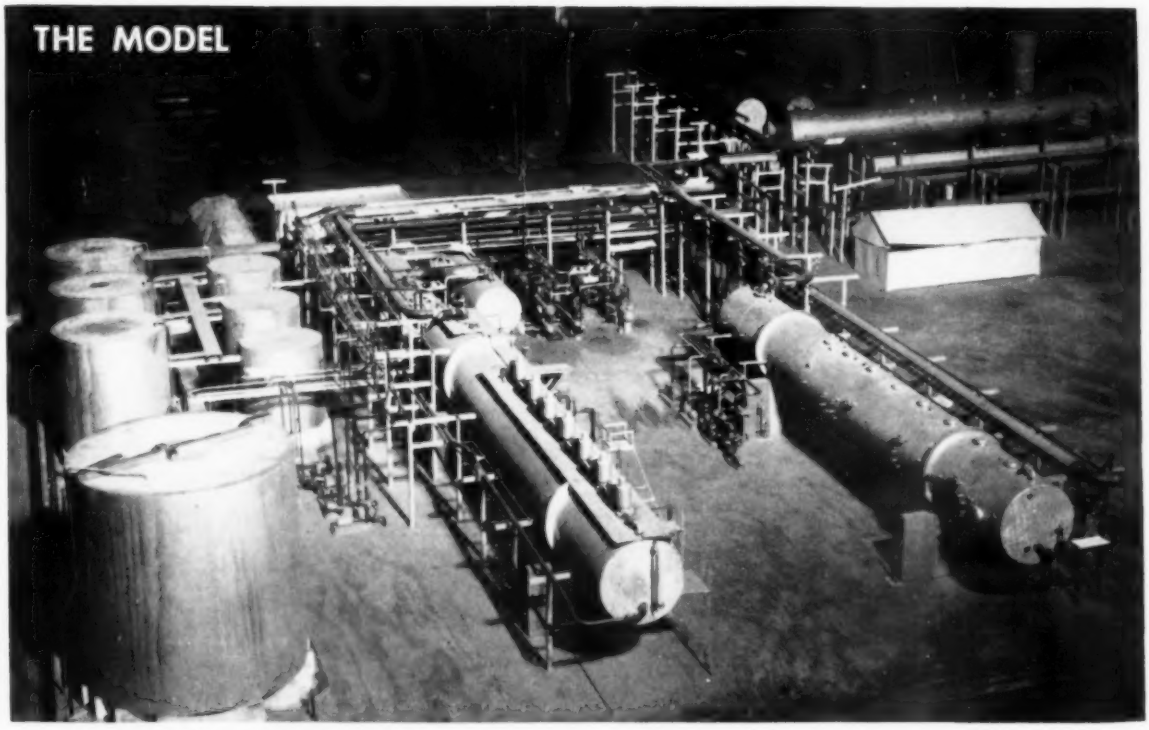
THIS MONTH'S M&C PANEL FEATURE

Models Simplify and Cut Costs of

A big design help, models now



SPACE PROBLEM WAS CLARIFIED for maintenance and construction forces by model (partially complete above) in installing new alkylation reactors (horizontal vessels at center below)

Big Revamp Job

aid in construction

By RON CANNON, Southwestern Editor

HUMBLE Oil & Refining Co. at Baytown, Texas, recently made a tough job easier by using an old tool a new way. Engineering Division men put a fully piped scale model to work for them during design, planning and construction of a major modification of its aviation alkylation unit.

Though models are fairly widely used in new-unit design (PP 4'57 p90, 5'57 p222), use for revamping is something new. Humble feels that its model, which was used for pre-planning, unit layout, working drawings, and construction planning, more than paid its way. Actual cost was about $5,000, including all labor and materials. This is less than 0.2% of the total cost of the revamped alky unit.

From their experiences with this, their first use of a complete design model for a revamp job, Engineering Division personnel point out that its single most important function is as an instrument of communication. The model—compared with conventional drawings—will get more information across . . .

—to a greater number of people
—in a shorter time
—at a lower cost
—more accurately
—in more understandable terms

Quantitative evaluations are difficult to obtain, but Division personnel are convinced that the communications factor alone resulted in the following five advantages:

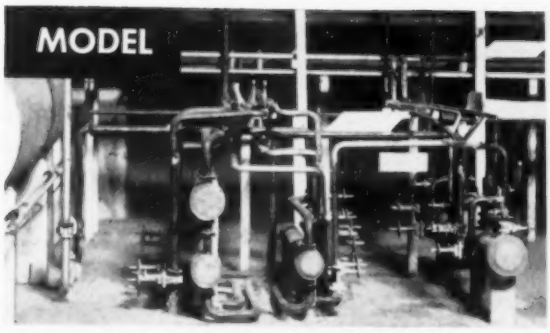
1—Faster and more complete agreement among all concerned at every stage of the job.
2—Easier and less expensive design changes.
3—Less skill required to make the working drawings.
4—Cheaper and faster drafting.
5—Better construction planning.

Although models have been used by Humble before, they are not standard procedure, nor have they ever gone much past the "plot plan" stage. Several factors influenced the Division's decision to apply the "completed model" technique on the alky job:

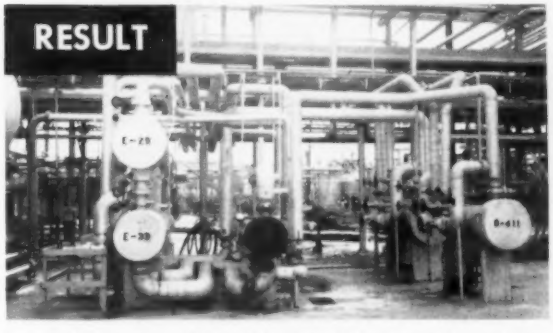
1—Manpower shortage: Draftsmen were scarce at the time the job was started and the Division wanted to fill the breach with men who were skilled craftsmen, but who had no formal drafting training. It was felt that a model would simplify the process of translation from a three-dimensional concept to a two-dimensional drawing for these men without extensive and time-consuming training.

2—Experimental purposes: Humble wanted to evaluate the much-ballyhooed new design aid and see, firsthand, just how the use of models would fit into its own engineering work.

3—Unique job: The modernization as planned was to be a complex rebuilding project with much existing equipment remaining in service. In addition, major replacement components were to be radically different from those replaced.



MODEL ELIMINATED INTERFERENCES not apparent in the design . . .



. . . **before trouble could start** during actual project

4—Crowded area: The old unit area was already overcrowded; real estate was at a premium. Much juggling of equipment was expected in the early planning stages to obtain the best layout, both from an operating and construction standpoint.

The problems

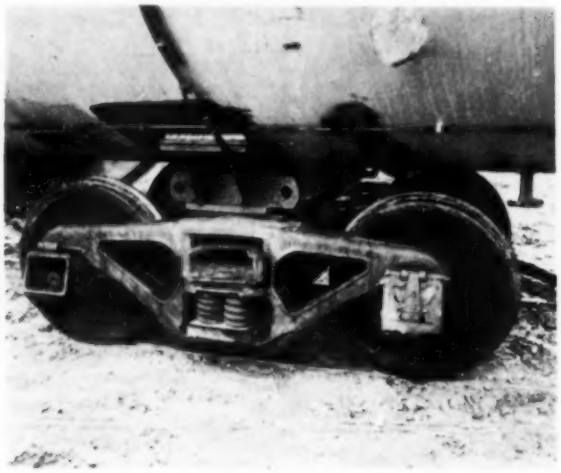
The existing alkylation unit was a 9,500 b/cd unit that had been built in two stages. It had five vertical reactors—three of which utilized equipment built about 1935 that was rapidly approaching obsolescence. The other two reactors, also vertical, were added to the unit in a war-time expansion, and were serviceable.

Process plans called for replacing the three older reactors with four horizontal-stirred reactors of modern, efficient design—to result in a 13,000 b/cd unit with two vertical and four new horizontal reactors.

As in most jobs of this kind, the process area was

Guest M&C Panelist

Because of the unique approach to maintenance and construction problems through the use of models described in this article, the regular PETROLEUM PROCESSING M&C Panelists have relinquished this month's space to a guest author, one of PETROLEUM PROCESSING's own staffers, Southwestern Editor Ron Cannon. The regular M&C Problem Corner does appear, however, and will be found on p. 52.



STRIPPED-DOWN truck saved height

SHARP CURVES compounded problems

"Vessels could not be brought into the unit on

Closeup, photo above, shows stripped-down car truck used to move reactor vessels into alkylation process area. Use of these trucks saved 18 in. of valuable clearance height. In some spots, however, this was not enough, and the track bed had to be lowered as shown on the facing page. Not only were clearances tight, as little as 1/16-in., but the vessels had to be maneuvered around impossibly sharp curves. One of these is shown in the cen-

crowded and construction had to be done in stages—with the unit running at full capacity. In the broadest possible terms, the job was planned in the following steps:

1—Erect and place in operation two new reactors, then . . .

2—Remove from service and dismantle the three obsolete reactors, to provide space to . . .

3—Erect and place in operation the remaining two new reactors.

These steps are described here in what is a gross oversimplification of the problems. Before Step 1 was begun, room had to be found in what was already a jammed area. The new reactors were 12-ft dia. by 109 ft long, weighing about 102 tons each. To provide room for two of these vessels, plus all accessory equipment and access areas, was a challenge to any planning group—six storage tanks had to be moved, lines rerouted, pumps relocated, and more pipe stanchions added.

Biggest complication to Step 3 was the inaccessibility of the area—storage tanks and operating units had it hemmed in on all sides. Even with the space provided by dismantling the three old reactors, there was considerable doubt as to just how to move the new vessels to the site.

The model

With a basic scale layout of the area, and scale models of the major equipment—both existing and proposed—the Design Department soon had what it calls an "equipment arrangement" model of the proposed finished unit. The equipment arrangement model is, in effect, a three-dimensional plot plan.

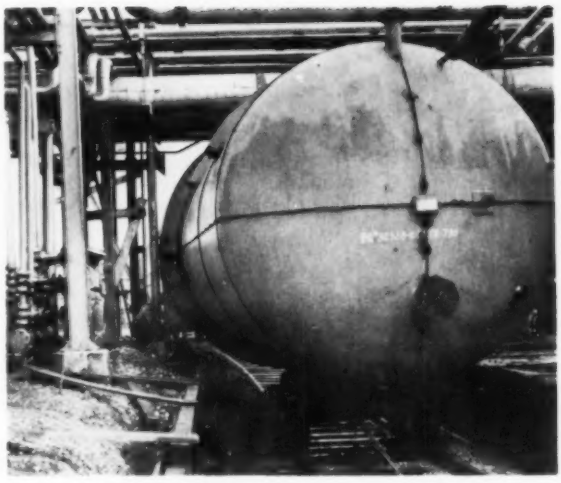
By shuffling the larger pieces of equipment around on the area layout, all possible arrangements were quickly investigated and the effects of each possibility were immediately obvious. With ten to twelve people directly concerned, suggestions and objections were plentiful, but within an hour's time, a plan acceptable to all was agreed on. At this stage, the model approach was several weeks and many hours drafting time ahead of the conventional approved-drawing method of initial planning.

An added blessing—incidental, but important to the Design Department—was that the Engineering Division was able to proceed with the final design with more than usual confidence that the plan would be acceptable simply because everyone had a clear picture of the final arrangement of the unit.

Work on the model began in June, 1955—one area at a time. Working from process and mechanical flow diagrams, the model builders began the unit arrangement and piping for the relocated chemical handling and storage equipment. Working drawings followed each stage of the model by about a month. The model, including several major changes, was completed about a year later. This time is not indicative of actual working time on the model—the builders were pulled off from time to time for other projects and the job was such that they were required to stay just ahead of the Drafting Department.

Scale for this model was ¼ in.=1 ft. Strictly utility, the model was not painted or carried beyond its intended purpose of conveying information. Identical piping and accessory equipment arrangements—for example, at the reactors themselves, were not duplicated on the model.

Materials, with one exception, were available in the plant. Equipment models were fabricated from wood; standard gage wire and wood dowels were very close to true scale for pipe sizes. Scale model clip-on valves were purchased from an industrial model supply firm.



CLEARANCES ran down to 1/16-in.

conventional railway cars"

ter photo. Use of the model greatly simplified much of the planning involved in modernizing and modifying the unit. A "dry run" was actually used to solve rigging problems before they arose.

How the model was used

The model was most helpful for unit design and drafting work. Eight pipefitters, who had no prior drafting experience, completed all piping drawings for the multi-million dollar project. Working from the completed model, their work was such that the field changes were very few and very minor. In addition, these men are now well-grounded draftsmen, able to assist the Engineering Division during peak loads, and much more adept at interpreting engineering drawings during regular work.

Even with the carefully planned layout, the model picked up many design and layout faults that would have been difficult to see on a conventional drawing. Beginning with predetermined spacings, for example, physical interferences between piping components became obvious when scaled on the model. One of the most striking examples was the arrangement of a complicated valve manifold on a group of heat exchangers and driers. The complexity of the manifolding and piping in this case was such that the model brought about a meeting of minds that would have been impossible with sketches.

Civil, electrical, and instrument designers also found the model an invaluable aid in locating conduits, lighting standards, platforms, and structural supports for greatest convenience in operation and maintenance.

Construction forces also made good use of the model. At the jobsite, piping crews were able to study the model and get a much clearer picture of the completed unit—resulting in better planning of work and more efficient use of manpower. On a job of this kind—long and drawn-out by necessity—there are likely to be many changes of personnel during the course of construction. The model was a big help in showing the nature and status of work to a frequent turnover of the crafts.

Riggers made "dry runs" on tricky rigging problems where there were questions on the best way to erect the larger pieces of equipment. For example, in moving the last two reactors to the site, there were two routes by which the large vessels could be brought in. One route —through the middle of the unit—was selected as best, *if* the vessels would clear all existing obstructions. A "dry run" with the model quickly showed which obstructions would have to be cleared. It also pointed out that the vessels could not be brought into the unit on conventional railway cars—too high and too wide, and a railway car would not take the sharp rail curves that the cramped space made necessary.

By placing the vessels directly on the trucks of the rail cars, the overall height of the rolling assembly was reduced eighteen inches. Even so, tracks had to be placed below grade at one overhead pipeway in order to get the vessels through. The sharp curves further complicated moving the equipment through the crowded area, but with the aid of the model, construction forces were able to foresee most of the problems and plan accordingly.

Operators also made good use of the model as a training aid in switching over to the new operation. While construction was under way, operating personnel were able to study the unit, follow the piping, and become familiar with all major operating components.

Cost savings

Humble hesitates to place a dollars and cents value on the cost savings realized. In the first place, dollar savings were not the primary reason for using the model. Secondly, any guessing of problems that might have popped up without the model would be pure speculation. For example, the main savings in drafting and design time resulted from the ease with which changes could be made at any stage in the job—before any drawings were made of that portion of the unit. How many changes might have occurred after first drawings were made is largely an academic question—several certainly, and the savings realized in this respect are the most important.

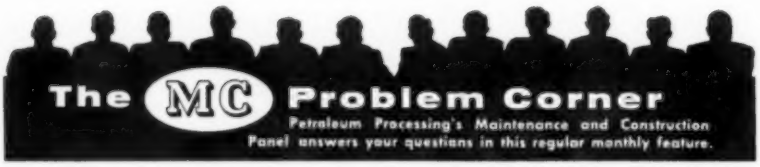
One major change is the process design took place after the model was well along. Original process plans called for three—instead of the final four—new reactors, and the model was built accordingly. Adding the fourth reactor changed the whole layout of the affected area, including piping, pipe supports and all accessory equipment.

The effect of such a change after all drawings were made would have meant scrapping hundreds of man-hours of drafting time. With the model—ahead of working drawings—a relatively small amount of money was tied up in design time.

Considering that the model was completely repiped, some parts as many as four times, as the result of major changes, it is evident that savings in design and drafting costs were considerable. Added to the countless savings that would be routine on any job, the possible payout should be a hearty recommendation for any large modification.

This is the largest job Humble has attempted with its Baytown plant forces, and the Engineering Division considers it a critical test of the model technique. As a means to an end—not the end itself—models of complex modification projects can be an effective, time-saving method of realizing better intra-plant communications and more acceptable unit designs.

Turn page for Problem Corner ⟶


The MC Problem Corner
Petroleum Processing's Maintenance and Construction Panel answers your questions in this regular monthly feature.

By RON CANNON, Southwestern Editor

How to stop pump leaks

What can I do about consistently leaky mechanical seals on pumps in wet propane service?
Refining, Southwest

(A discussion continued from the June Problem Corner)

Unlubricated, uncooled mechanical seals wear out rapidly. Liquid next to the sealing surface gives a slight amount of lubrication and helps remove heat of friction.

Insufficient cooling causes propane vaporization, and the natural circulation of propane is blocked in the sealing chamber giving a dry seal that will "breathe." The resulting expansion and vaporization of the propane through the leak causes frosting and sometimes ice formation between the seals—if there is water in the propane.

Forced circulation into the seal gland "D" from the pump discharge (for dry propane) will prevent vaporization in the seal. Circulation should be directly over or past the sealing surfaces.

Under-circulation causes dry seal and leakage, while over-circulation overloads the seal with pressure build-up.

A positive flow of cool, dry propane through the seal can be insured by a block valve and pressure gage on the outlet of the stuffing box before re-entry at the pump suction. An approximate pressure differential (between gland outlet and pump inlet) of 10-15 psi is used. The same results may be had with a properly sized orifice plate replacing the gage and valve.

A variation is to let the propane flow through the throat bushing "E" and into the pump suction.

If the propane stream is wet, it is better to circulate a dry hydrocarbon sealing liquid from another source, or dehydrate the wet propane stream.

Mechanical seal leaks for wet propane service are most likely during startup—probably from ice forming on the faces of the sealing rings.

A small amount of steam can be directed on the seal during startup to prevent ice formation. Remove the steam after the pump is fully on-stream.

A startup on butane or heavier liquids, later switching to propane service, can help prevent startup seal leakage.

Continuous steam flow can be used to put enough heat into or around the seal to prevent ice formation during operation. Steam can be used in a gland jacket, in tracing around the gland, or by blowing steam directly onto the exposed parts of the seal.

Where the stationary face of the mechanical seal (contained in the stuffing box gland) is completely enclosed with a steam jacket, heat is applied by radiation at the seal contact faces. In this case, 65 psi steam with exhaust to a steam trap is sufficient.

For further information on operating with light hydrocarbons, see "Tips on Sealing Light Hydrocarbons," by Ralph E. Morgan, PETROLEUM PROCESSING, Sept. 1953, pp. 1340-1.

Our herringbone gear pumps, used to transfer oxidized asphalt to storage, wear excessively on both the drive and driven gears. Is there a simple remedy for this? Is there some other type of pump that would work better?
Refining, East Coast.

ONE REMEDY for excessive wear on the drive and driven gears of herringbone pumps in oxidized asphalt service is to use an external timing gear drive.

In cases where the wear is caused by slate dust, gilsonite or lime dust added as a filler, there is no easy solution for gear pumps. The problem can be overcome by replacing the gear pump with a steam or power driven, steam-jacketed reciprocating pump, fitted with hardened stellite-surfaced rods. A suitable packing for this service is made by the Crane Packing Co.; however, considerable technique is needed to install it so that it will give the longest possible service. Another important tip is to be sure that the steam has been on the jacket and stuffing boxes sufficiently long to get the pump and rods completely heated before starting them.

Who Is on Your M&C Panel

The following M&C Panel members below send thought-provoking feature articles your way, and are prepared to answer your maintenance and construction questions through the pages of PETROLEUM PROCESSING:

- J. B. Adams, plant supt., U.S. Oil & Refining Co., Tacoma, Wash.
- E. B. Asmus, central maint. engr., Central Engrg. Dept., Sinclair Refining Co., E. Chicago, Ind.
- R. W. Best, mechanical supt., Cities Service Refining Corp., Lake Charles, La.
- C. C. Carmine, supervisor of maint. & constr., Tidewater Oil Co., Associated, Calif.
- C. D. Carnes, chief engr., National Petro-Chemicals Corp., Tuscola, Ill.
- L. L. Crowl, district supt., Champlin Oil & Refining Co., Carthage, Tex.
- V. J. Loyd, supv. of the maint. & corrosion group, Refinery Engrg. Div., Socony Mobil Oil Co., Inc., New York, N.Y.
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- R. D. Humphreys, maintenance superintendent, Canadian Oil Refineries Ltd., Corrunna, Ontario
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- A. P. Olbrich, chief maint. consultant, Refining Dept., Phillips Petroleum Co., Bartlesville, Okla.
- H. V. Wilks, plant manager Celanese Corp. of America, Pampa, Tex.

Please do not send your questions to the Panel members, but address them to:

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New York 36, N.Y.

In those shorter writing jobs

Do Your Ideas Get Across?

By STUART D. BOYNTON, Assistant Editor

QUICK communication is the point of your shorter writing jobs—memos, letters, and brief, informal reports.

The two musts for writing that gets across fast are:

- **Clarity**—in organization and in the sentences themselves.
- **Conciseness**—which keeps the writing relevant and light in weight.

You can learn how to make your writing a fast-moving transmission belt for your ideas. Adopt the suggestions in this article. If you are alert and willing to indulge in some self-criticism you can get results.

It is true that memos, letters, and the like are not the complicated job of writing that a full-scale report is. Yet the average technical man will spend more of his daily "writing time" on them than on the bigger projects. What's more, they are important—written work is what represents your capabilities to most of the people in your company. So work to make these everyday notes examples of fast communication. You will earn the gratitude and attention of the people who must read them.

It's your attitude

Good communication is partly a matter of attitude. Ideally, you should feel a certain eagerness about paring down sentences and re-ordering your ideas so they follow a more direct or logical path. Your words will have precision and animation when you're *on top* of the writing, not merely struggling to "get things down on paper somehow." If you can't always manage real enthusiasm for the job, learn the mechanics and the writing will still get ideas across faster and better.

Much technical material by its very nature is hard reading. However, the writing itself can slow down the reader in many needless ways. Norman Shidle, in his "Clear Writing for Easy Reading" (a "must" book for every technical man), states that people in technical work frequently have emotional difficulty in applying the techniques that make for better writing. But the alibis they offer—"he *ought* to understand me" or "he *ought* to be interested"—don't change the reluctance of readers to plow through turgid "engineering prose."

The technical man's job isn't done when he has collected the information and arrived at the proper conclusions. It's a part of this job to cut down the obstacles to quick, easy comprehension. When he has done this he will need no excuses about the shortcomings of the reader.

Start at the beginning

Clarity and conciseness—the essentials of quick comprehension—are built right into the bone and tissue of good writing. To follow this analogy, the bone represents the organization of ideas on the page, the tissue represents the ideas themselves. Without a deliberate and logical organization, even the most skillful use of language won't conceal the unexpected turns, the forced connection of thoughts.

But why this pleading for organization when the writing in question might cover no more than a single page?

Because you can create confusion even on one small page. And swift communication, even in a letter, means that not a wasted moment can be charged to the writer.

Take this letter for example (all proper names in it are fictitious):

Dear Mr. Jones,

I am writing in my capacity as executive secretary of the Corrosion Society of America, which is going to hold its 32nd annual meeting next May 13 in Dallas. As you may know, our group was organized to review contributions in the control of corrosion from research and operating people in petroleum, chemical, and other industrial companies where corrosion presents an operating hazard.

Several people in your company, among them Mr. Hackett, Director of Process Research, and Mr. Judson, Assistant Director of Product Development, are members of the Society and have addressed our group in the past.

Mr. Judson informs us that you have been working on alloy corrosion in certain petrochemical processes. We are wondering if we could interest you in delivering a technical paper on some topic in this general field at our May meeting?

We plan a special feature for that meeting, "Corrosion Hazards in the Petrochemical Plant," and that makes this invitation especially appropriate. We thought a paper on corrosion in ammonia manufacturing might be particularly valuable, but we'd like to hear your ideas on this . . .

When reader Jones starts out with this letter, he expects perhaps an invitation to join the Society, or to attend the May meeting in Dallas. After reaching the third paragraph in this state of expectation, he learns the real purpose of the letter. Suggestions about the exact subject of the paper are separated from the invitation.

This "backing into the subject" won't baffle Mr. Jones. But it will surely slow him down. And if he's in a hurry, he may quit reading before he has arrived at the important point of the letter.

The faults are primarily in the letter's organization. The writer had no mental outline and no clear notion of what was most important to the reader. Conciseness is lacking because the ideas are in haphazard order. Some are not even relevant to the point. (Why mention Hackett if only Judson is important here?)

What's a better way?

The writer should have at least a mental outline to insure a logical progression of his ideas. If he's doing

a memo of more than one page in length, it is advisable to have a written outline, or at least points jotted down in proper sequence.

Beyond that, here are some guides to better organization. They will fit most of the short writing jobs you face.

1—Open with a brief statement of the problem, or the topic of previous correspondence.

2—Follow with recommendations, or requests or conclusions.

3—Add detail about background, but only that which is pertinent to the subject.

4—Tell why you made recommendations or conclusions.

5—Give each point a separate paragraph. Spread the background detail over several paragraphs if it is long. In any case, provide breaks in the writing (by paragraphs) when there are major breaks in the sense.

In general, the best rule to follow is simply this: don't bury important things. Recommendations, requests (both ask for action), the topic or context, and conclusions are the most important elements from the reader's point of view. They should be arranged so they can be spotted without difficulty.

The speed of language

You don't plant flowers in a bed of weeds, so why let excess words stifle the clear sense you are trying to convey in your writing. Use language pruned down to the essentials, just as you use organization to separate and emphasize important matter, and to arrange the elements for rapid assimilation.

Joseph N. Ulman has collected a few "extra-baggage" expressions in his helpful "Technical Reporting":

Substitute . . .	for . . .
because	due to the fact that
therefore	for this reason
although	despite the fact that
estimate	make an approximation of
most	the greatest amount
to	in order to

Many words you use are actually superfluous. Take relative pronouns for example:

The naphtha fractions that are *under consideration were processed from crude oils* which are *found in the Tia Juana area.*

Omit the words shown in roman type. The sentence is shortened and the reading speeded up. Naturally, you can't cut out all relative pronouns. Yet, in many cases their omission doesn't affect the sense and does give a definite boost to the writing.

Changing indirect expressions to direct ones also helps conciseness:

Use . . .	instead of . . .
apparently	it appears that
should	it is felt that
note	it should be noted
must	it is essential that

Often, but not always, the indirect form is unnecessary.

But, conciseness practiced for its own sake can work *against* clarity too. As several authorities have pointed out, it's the *density* of writing as well as the length of words and sentences that affects clarity. For example:

Completion of recommendations submitted herewith, and utilization of the attached efficiency charts, should facilitate maintenance of optimum furnace efficiencies.

This sentence would make anyone stop and blink. Although it isn't exactly short, you see many longer sentences that are easier to read. Also, the words are not unfamiliar, and no technical man would reach for a dictionary. That bulky, indigestible appearance in this sentence comes from density and not from length or unfamiliar words. There has been an overuse of words ending in "shun" and "shiency" here. Cut them out where possible and the sentence becomes:

These proposals, and use of the attached charts, should help us maintain optimum furnace efficiencies.

If the word "us" is inappropriate (and it usually is not), "help to maintain . . ." would still be an improvement over the original sentence.

Watch those multi-syllable words. Use instead their short, simple synonyms. Don't be ashamed of using two simple words for one of several syllables. Contrary to the popular impression, you won't lose professional "face."

In fact, most of the reason for bulky writing is that many people refuse to write in a natural way. You would never speak the way that first paragraph above reads—even to a superior. You would seem very stuffy if you did. Neither would you speak exactly in the style of the revised version, but it comes closer to speech and would not be thought unnatural. A natural, unadorned style will go far to make your writing easy and quick to read.

Now it's your turn

You can add to the list of words and phrases that block quick comprehension. The list is endless and you probably see a good portion of it every day. If you want to perk up your writing, though, don't look all the time at what others write. Make a list from your own letters, memos, reports, etc.

Find the extra-baggage words that you use: introductory "howevers" and "moreovers," superfluous words, qualifying phrases. Ask yourself whether they really add sense to the passage or merely rob it of speed.

Find the long words you use with the aim of stretching your vocabulary or giving variety to your writing. Ask yourself in each case whether they are words that are likely to be understood by your readers. If they are really exotic, you can be sure a shorter synonym would be better.

Mark the long sentences you've written. Keep them in mind when you write again, and be sure you at least try to divide them. Spread your ideas over more sentences and each will be comprehended more quickly.

See if you've organized your writing so leading ideas really do lead. Does the recipient know right away what is expected of him? Does your detail support or lead up to a major point?

The main idea is to build up a consciousness of organization and style within yourself so that when you next write you will be on your guard. Considering readability will become a habit. You will learn the dangers and develop habitual ways of avoiding them.

With these steps in mind you can put your ideas down on paper so they will lift right up into the mind of the reader. This is fast communication.

RADIOISOTOPES

. . . The Refiner's Everyday Tool

By STUART D. BOYNTON
Assistant Editor

THE fixed radioisotope source offers petroleum refiners a fast-working, cheap tool for everyday use. As new as radioisotopes are in industry, some simple applications have been worked out that today are in regular use in processing plants. What plant manager, if he knew about them, would balk at spending $1400, plus the cost of some extra training for two of his engineers, for these economies:

- Cheaper, easier maintenance of vapor lines. With a fixed radioisotope source you can obtain an accurate measurement of sediment in lines *before* trouble develops. This helps the scheduling of maintenance operations because it can be known just which lines are building up deposits. And it saves the cost and trouble of opening all lines for cleaning when only a few in the unit need it.
- A quick way of checking liquid levels in vessels for which conventional gages are not entirely reliable, e.g., high or low temperature, or pressure, vessels; and vessels with highly corrosive materials. The fixed source can be used to confirm the readings of the conventional gages or, where the latter don't work well at all, replace them. When a permanent radioisotope gage seems desirable, there are several types commercially available and easy to install.
- Better catalytic-cracker operation. The fixed source can be used as a fast-working troubleshooter for circulation problems in the regenerator standpipe and the reactor feed line. Quick solution of difficulties here can pay for the radioisotopes and equipment many times over, when you consider the value of product run through a cracker in a short interval. At a cracking plant startup the fixed source can be an invaluable aid for rapidly establishing proper aeration.

Here a few of these applications are demonstrated by a team from the process instrumentation group, technical service division, of Esso Standard Oil Co.'s Bayway refinery. These reliable radioisotope "tools" are often used for trouble-shooting at the refinery.

The applications shown are just a few of those developed at the refinery, as they would be anywhere. Once you become familiar with radioisotope techniques, new applications are always being found for the special problems of your plant. But even these few uses will, in most cases, justify the investment required. Let's look at this investment.

How the refinery uses radioisotopes

Radioisotopes have been used generally in two ways: as tracers, in which case they are injected right into the process stream, and as fixed sources of radiation. In the latter case the radioisotope, in a container, is placed against one side of a vessel or pipe, its rays beamed through and picked up by a detector placed on the opposite side. Some of the energy of the rays is absorbed by the vessel walls and the material inside. The detector reading is compared with a reading taken from an empty vessel of similar size and wall thickness. The difference is a measure of the density of the material inside the vessel.

This article deals only with radioisotopes used as fixed sources. Tracer work may ultimately be the more important type of application of atomic radiation, but it requires more complicated equipment, better preparation, and greater precautions than work with fixed sources. The fixed source is something every processing plant can afford, and use, *today*.

Sources (Cobalt-60)	
50 millicurie	$175
15 mc	160
1 mc	75
Total: 66 mc	$410
Detectors	
Geiger-Muller counter	$210
Scintillation counter	570
Total	$780
Storage vessels for sources	
4-hole type	$180
single-hole type	45
Total	$225
Grand total: $1415	

There is also the cost of personnel radiation-detection devices, which depends on the number of people using the radioisotopes. Film badges must be worn by everyone handling the sources. They are sent off to a service firm for developing every week and the cost runs around 60¢/wk/badge. Pocket dosimeters are carried by every radioisotope worker and a daily reading is entered into his rec-

RADIOISOTOPE KIT for up-to-date processors. Holding-rod for cobalt-60 source, devised by Esso, permits operator to minimize his exposure. Lead collimator has hole at the bottom, which focuses rays into narrow beam. Also shown are scintillation detector with external head, and lead case for carrying sources not in use. The cobalt radioisotope is in the needle lying between holding rod and collimator.

ord. Dosimeters cost about $40 each.

Cost of equipment and radioisotopes was taken from the catalog of a major supplier. Choice of radioisotope depends largely on the jobs to be done. Having several at different strengths gives you greater flexibility to handle the problems that arise. Probably the most popular source for these simple jobs is cobalt-60, an emitter of gamma rays. These have the advantage over other types of radioactivity because of their high penetration, so that it is possible to beam them through vessel walls of practically any thickness likely to be encountered in a refinery. The 5.3-yr half-life of cobalt-60 assures you of having a source of reliable strength for a reasonable length of time.

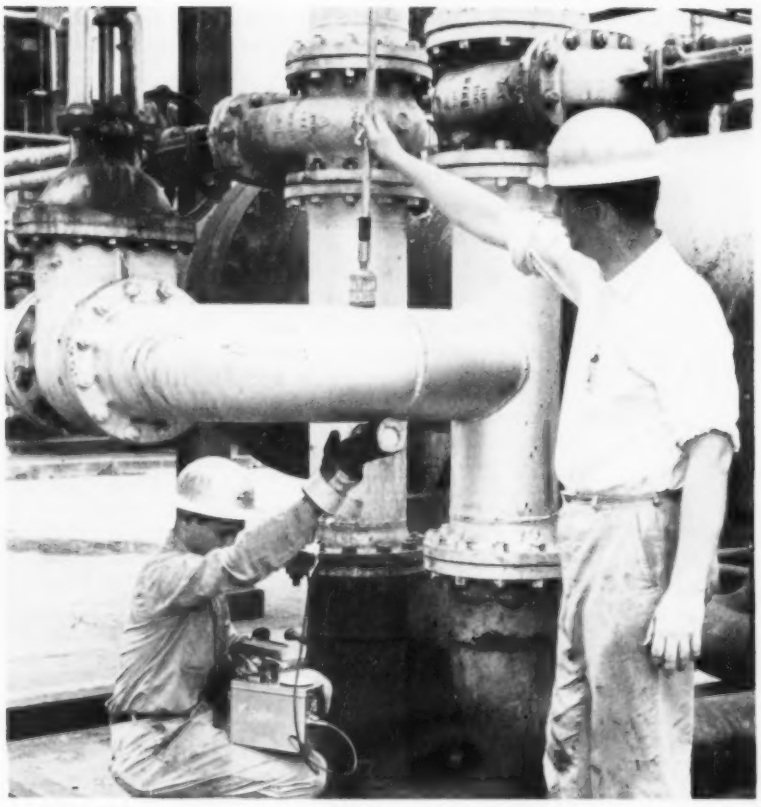
The investment could be reduced to about $1000 and still provide a highly useful kit. The larger investment permits a greater range of applications, however.

There is, of course, a certain procedure to go through before you are licensed to possess radioactive materials. You must apply to the Atomic Energy Commission and describe the radioisotopes you want and your qualifications to use them. No precise requirements are set by the AEC, but the Commission expects the people using the materials to have both training and experience.

Training can be taken at certain AEC facilities, Public Health Institutes, universities, and suppliers of radioactive materials (see PP, Mar.,

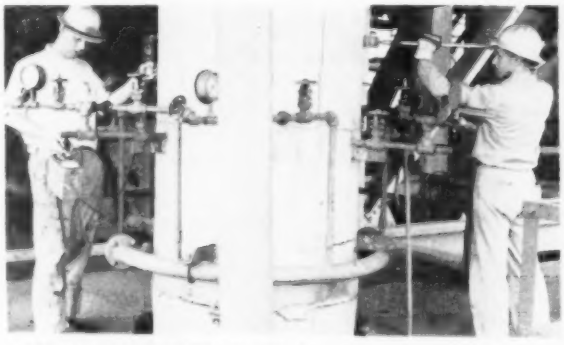
SEDIMENT DEPOSIT in the safety flare-stack lateral is measured by Jim Stoddart and Gene MacMullan. Horizontal reading through line is preceded by vertical reading. Sediment can then be calculated to close accuracy. Technique can be used for sediment in any vapor line.

EXPOSURE to radioactivity is measured by pencil-shaped dosimeters (usually worn inside breast pocket) and film badge on belt.



TAR BUILDUP on inner surface of cat-cracker slurry pumparound circuit can be quickly found by team. Here Gene MacMullan and Earl Goodling, alerted by pressure drop, look for fall in level of radioactivity reaching the detector. This will signal location of tar buildup.

CHECKING LIQUID LEVEL of a high-pressure vessel. At the surface point there is a sudden change in amount of gamma rays reaching the detector. Team can verify accuracy of conventional gages in this way.



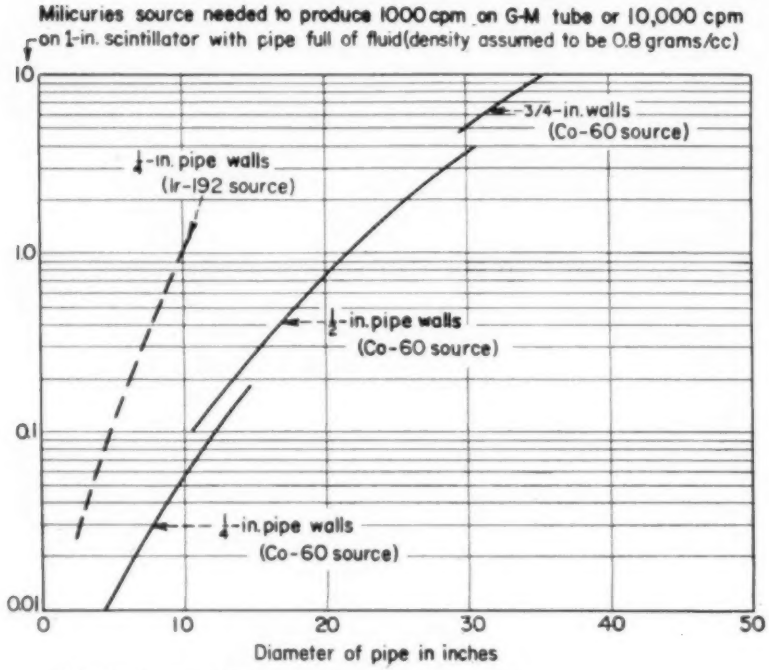
POOR CATALYST FLOW through a regenerator standpipe of cracker shows up as sharp fluctuations on the detector. By checking from floor to floor, team can quickly pinpoint where changes are needed in aeration.

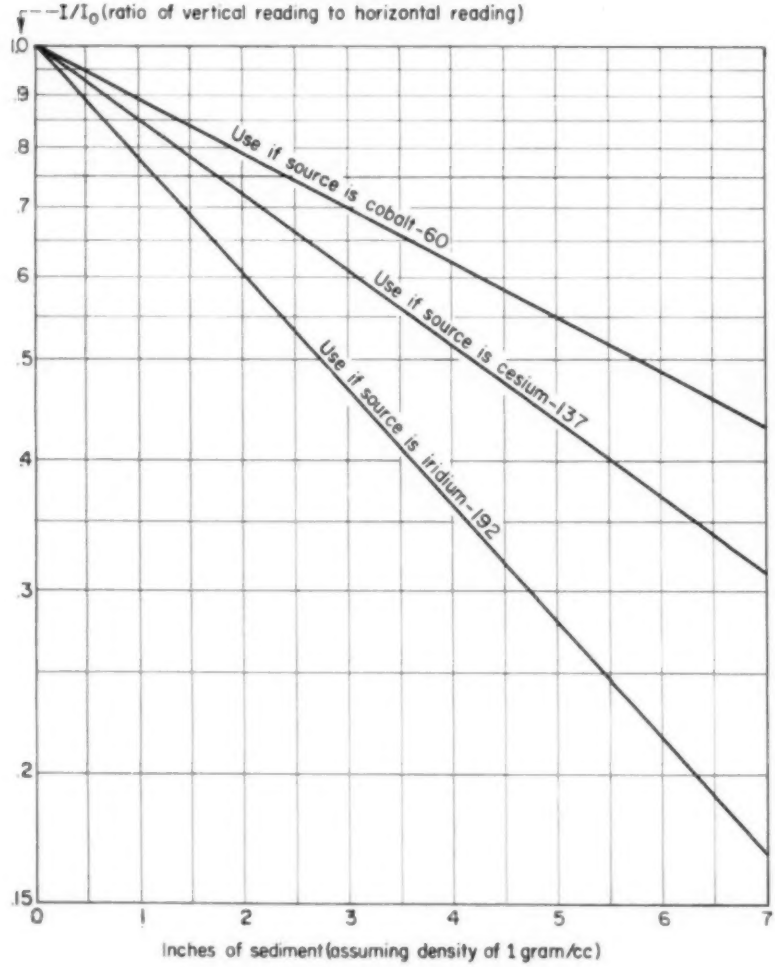
1957, p 68). The AEC also requires a certain amount of practical experience in the type of work for which you want a license. Other refineries already using radioisotopes might provide this. The license application (Form 313) also asks for information about the radioactivity-monitoring devices you will use and about other precautions. But for the small quantities of material discussed here, special arrangements needed are few.

The author wishes to thank Jim Stoddart, of Esso Standard Oil Co., for his help in the preparation of this article.

See shortcuts on next page

Two short-cuts for your radioisotope work





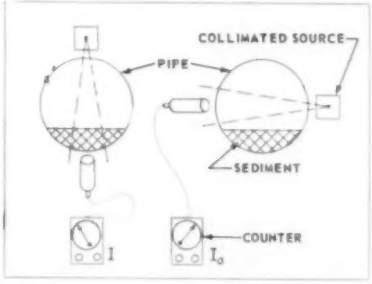
How strong a source? Use the graph to the left when you want to pick the right strength of radioisotope for applications involving fluid filled pipes and vessels under 40-in. in diameter. Finding obstructions on the inner surface of a pipe and gaging liquid levels in small vessels are two such applications. The graph can be used only for liquid-filled containers, and liquid density is assumed to be 0.8 grams per cc. For fluidized solids, where the density is greater, a slightly stronger source can be used.

To measure sediment layers in vapor lines you can usually pick the source strength by rule-of-thumb. The choice will probably fall between 1/10 of a millicurie and 2 millicuries, depending on the pipe diameter. For instance, with cobalt-60, 1/10 millicuries would be adequate up to pipe of 12-in. diameter. From 12 to 20-in. a 1 millicurie source would be practical. Actually, for greater accuracy in vapor lines with diameters under 16-in., a better radioisotope is iridium-192. Its lower energy emissions are more sensitive to the density of the materials.

A scintillation counter is better than a Geiger-Muller counter for this work because it has a wider counting range and therefore can be used for a greater variety of source strengths.

How to measure sediment. The lower left graph will help you measure the sediment deposit in vapor lines. As the cross-section drawing below shows, first a vertical reading is taken through the pipe, then a horizontal reading. Next, find the ratio of reading 1 to reading 2. Align this point on the ratio scale with the corresponding point on the proper radioisotope curve and you have the thickness of the sediment layer measured in inches. The scale along the bottom assumes a sediment density of 1 gram per cc.

For the material on this page, the author wishes to thank W. H. King, of Esso Research and Engineering Co.



WHEELER

McGREGOR

LOGWINUK

MADDOCKS

THORNTON

HAIG

FORTER

HARDCASTLE

BOCHOW

JONES

HOUSER

PETROLEUM PROCESSING tape recorded the last regional meeting of the Western Petroleum Refiners Ass'n in El Dorado, Ark. Here is the sixth series of technical tips on processing problems from the complete transcript (checked for accuracy by each speaker). Moderator of the panel of authorities that answered all questions was Harry K. Wheeler of Pan-Am Southern Corp., El Dorado, Ark. Members of the panel were: D. W. McGregor, Lummus Co.; Dr. A. K. Logwinuk, Houdry Process Corp.; R. R. Haig, Esso Research and Engineering Co.; A. A. Forter, Cities Service Refining Corp.; C. A. Hardcastle, Lion Oil Co.; Carl E. Bochow, Suntide Refining Co.; Bruce Jones, McMurrey Refining Co.; Mark E. Houser, Republic Oil Refining Co.; R. R. Maddocks, Blaw-Knox Co.; and D. P. Thornton, Jr., Universal Oil Products Co.

This month's technical tips on . . .

Catalytic Reforming Problems

? Raw visbreaker gasoline: Are there any data available on catalytic reforming of raw visbreaker gasoline?

Mr. Logwinuk

Logwinuk: We have not run any raw visbreaker gasoline, but we have operated with coker naphtha. The important thing to remember is that raw visbreaker or coker naphthas cannot be run through a reformer unless they are treated first. After treatment, these naphthas, of course, cannot be considered raw; in essence, they have properties similar to those of the virgin stocks in the same boiling range.

At the Gere refinery in Germany, a 3,500 bbl Houdriformer is operating on a feed composed of 50% coker and 50% straightrun, having a PONA analysis of 51, 20, 20 and 9 before treatment. The untreated charge is contaminated quite heavily with arsenic, lead and nitrogen and has an octane number of 39 F-1 clear. The stock is treated in a cobalt moly pretreater and then run through the Houdriformer. The operation is run for high yields (for this type of stock) of 84 vol—% and an octane of 71 F-1 clear. The product has very low gum and less than 0.01% sulfur.

Downer (The Refining Engineer): How do you hold down the increase in reaction temperatures across the cobalt moly reactor with the amount of unsaturates you have in catalytic naphtha?

Logwinuk: We never encountered any wild temperature increases. The temperature increase was orderly, amounting to about 90°F across the catalyst bed. Although a quench connection was provided, no quench was required at any time.

? Rexforming vs. Platforming: When running for the same octane number, how do the yields of a Platformer compare with those of a Rexformer? Also, how do the reactor inlet temperatures compare?

Mr. Thornton

Thornton: When running below a 95 octane Research clear, there's very little difference in yield between Rexforming and Platforming. The divergence begins to occur about 95 octane clear and up. The Rexformer yields are considerably better than would be expected from Platforming when operating to produce a product in the range of 100 to 102 or 103 octane clear.

The reactor inlet temperatures in Rexforming normally are lower than

in Platforming for the same octane quality because you are removing from the reactor effluent the low octane hydrocarbons which, in effect, are degrading the octane number. These materials are returned to the reactor system and, for all practical purposes, recycled to extinction. Consequently, you do not need as severe reaction conditions in Rexforming as you do in Platforming to secure a very high octane product from the same feed stock.

Mr. Haig

Haig: I just want to say that our experience is pretty much the opposite. Instead of under 95, I'd say under 102 we get the same yields for once-through catalytic reforming (not Platforming) compared, of course, with your published figures —we don't have a Rexforming plant. If you have a regenerative process, it is more economical, too. In a semi-regenerative unit, it would be very costly to try to go that high.

Thornton: Regeneration or non-regeneration has little to do with the yield comparison between once-through and recycle types of catalytic reforming. It seems to me that there is confusion on this point. The fact is that higher yields are inherent in a recycle type of operation because the reaction conditions employed are not as severe as those that must be used in once-through reforming to the same octane quality.

You see, for a given reformate octane, the recycle product will require a lower aromatic content than the once-through product will, because the non-aromatic portion of the product of recycling consists predominantly of the high octane hydrocarbons, as I mentioned a moment ago.

Catalyst life expectancy is greater in a Rexforming (recycle) operation producing, for instance, a 100-plus octane product, than in Platforming (once-through). We have very satisfactory experience reports from Platforming catalyst life in high severity operations. Although our Rexformers have not been operated long enough yet to confirm, with commercial data, our conviction that catalyst life will be at least as long as we have already experienced in commercial Platforming, early indications are that this will be so.

? Naphthenes in reformate: What per cent of naphthenes are left in the reformate at a given severity level? What is the theoretical maximum aromatic content of a reformate and how does this compare with the actual?

Logwinuk: We haven't checked very many commercial operations on the naphthenes left in the reformate at a given severity level, but I have one in mind in which the charge material contained 50% naphthenes. At 85 severity, about 8% of the naphthenes were unconverted; at 90 octane, 4.5% were unconverted; and at 95 octane, 1% of the naphthenes were unconverted. Of course, this will asymptotically approach zero because it is an equilibrium reaction and depends on the conversion of the C_6 naphthene to a C_6 naphthene by isomerization then aromatized to the aromatic.

Haig: I can add some other numbers. Their general import is about the same as Alex's, that you have a rapid drop in naphthene content and then a very slow reduction—apparently because of this equilibrium between the two reactions going on.

For example, I have one feed with 49% naphthenes with samples taken out of four reactors in series. Coming out of the first reactor is 72 octane, 26% naphthene; the second reactor, 79 octane, 8%; third reactor, 85 octane, 6%; the last reactor is 91 octane at 3.4% naphthenes. The yield of C_5 + at the end was 86% of feed so you would multiply that by the 3.4% figure to get the actual per cent on feed of the naphthenes left.

We have one other starting with 50% naphthenes and going to 97½ octane clear, where we finally did get down to 0% naphthenes.

? Reactor inlet temperatures: What is the advantage, if any, of operating reactor inlet temperatures at different levels compared to operating all inlets at same temperature?

Thornton: As was mentioned in an earlier question, an attempt is made to approach an isothermal condition. Generally the greatest temperature drop will occur in the first reactor. But what you're trying to do is to keep the average temperature on the catalyst in each bed as nearly the same and as low as you possibly can for the desired conversion.

For example, if you use the first reactor at, say 950, you may take a 125 degree drop. The drop in the second reactor at a slightly lower inlet temperature will be maybe half that. And in the third reactor there would be an even smaller temperature drop. At any given product octane level desired, to operate them all at the same average bed temperature requires a decreased inlet temperature for successive reactors.

If, on the other hand, all reactor inlet temperatures are kept the same, average bed temperatures will increase from reactor to reactor. Hence, by keeping the same average bed temperatures, and keeping this temperature as low as the desired octane rating will permit, you will increase catalyst life and product yield.

? Catalyst life: What is the experience of catalyst life in barrels per pound versus severity?

Mr. Wheeler

Wheeler: I'll get a chance to make a plug this time. In a regenerative unit it apparently has no effect, but Dave Thornton, what about a non-regenerative one?

Thornton: The harder you hit your catalyst, that is, the greater the severity used in processing, the greater the reduction in reforming catalyst life in a non-regenerative process, such as Platforming.

But we have never felt as you that it's necessary to recommend that a Platforming unit or a Rexforming unit catalyst be regenerated in situ. As shown in the paper we presented at the WPRA meeting in San Antonio earlier this year ("100 Octane Gasoline By Once-Through Platforming—a Commercial Reality," by Davis Read and P. C. Weinert), we have had some very satisfactory catalyst life experiences at extremely high octane ratings.

There are some as yet unpublished data, which we are hoping to get permission from the licensee to use, that will show the behavior of some of the newer catalysts we have been using of late for very high severity operations. In general, our philosophy is, and has been, to avoid regeneration by process and catalyst improvements for specific processing situations.

Logwinuk: I should like to point out that swing type regenerative operations are still fairly new and there may be problems in the deposition of sulfates on the catalyst, resulting in an adverse effect upon catalyst life. I think it's a little too early to say just what the catalyst life will be in a regenerative set-up because of these sulfates. Some sort of a set-up will have to be provided to remove them.

Wheeler: I have to disagree, Alex—it's not relatively new. We've been doing it at El Dorado for about two years. I do agree with you, however—sulphate is a problem. But based on our commercial operation, and others, it appears that if you put in the desulfurizer as everybody seems to be doing, and get the sulphur out of the feed, it should not be a problem.

Mr. Jones

Jones: As a mater of interest, I'd like to know what are some of the catalyst lives that have been experienced on these regenerative catalytic reforming processes — before you dump the catalyst—in bbl/lb.

Wheeler: Well, we haven't dumped it yet.

Jones: How many bbl/lb do you have?

Wheeler: It varies because we've kept increasing our loading as the octane has gone up. I think our oldest is 100 bbl/lb. I think we're right. I know we're the oldest in days but there might be some folks with Ultraformers approaching that number in bbl/lb.

Logwinuk: Ohio Oil, operating a Houdriformer, has experienced a catalyst life with one regeneration of 112 bbl/lb.

Thornton: The longest Platforming unit run without change of catalyst that I can recall, went to a catalyst age of approximately 250 bbl/lb. There have been many runs in which catalyst age has exceeded the 100 bbl/lb mark while producing Platformates that rated in the 95 to 97 Research octane, leaded, bracket and a number of others in which 200 bbl/lb was exceeded.

The WPRA paper that I just cited mentions a Platforming unit that processes a Gulf Coast naphtha having a boiling range of 200 to 375°F, which contains less naphthenes than the usual Coastal stock. The Plaformate obtained from this unit in "normal" operation tests about 95 octane, Research, with 3 ml TEL/gal.

Of particular interest in this connection is a demonstration made during an otherwisee "routine" run. When the catalyst age was 22 bbl/lb, the unit was operated for a week at conditions consistently producing Platformate in a yield of over 90 liquid vol-% that tested over 100 octane with 3 ml TEL/gal.

When the unit was returned in the following week to producing its normally scheduled 95 octane leaded product, there was no evidence that the high severity test operation had reduced the catalyst activity. The unit was shut down when the catalyst age reached 118 bbl/lb. This catalyst was never regenerated.

Wheeler: We're getting some good numbers to shoot at here today, anyway. You'll have to explain to management when you dump that catalyst now why you can't get 135 bbl/lb.

? Reformer feed end-point: What is the practice of various operators with regard to: Restricting end-point of catalytic reformer feed, and re-running feed? What experience is available to demonstrate the value of any such restrictions?

Thornton: One of the particular effects of catalytic reforming is to raise the end-point of the product by virtue of forming the various aromatics. Consequently, if a 400 end-point naphtha is used as a charge stock, it's very probable that the end-point of the product will be 425 or 430! Consequently, if you don't restrict the end point of the charge, you probably will have to re-run that gasoline to stay within reasonable gasoline boiling range. An exception to this would be if you particularly desired to make the heavier aromatics.

White (International Refineries): Do you find the higher end point naphtha tends to give you more carbon deposition on your catalyst?

Thornton: You would adjust that by selection of operating conditions, to a considerable extent. I can't give you any definite data; I'm sorry.

Wheeler: I think I heard that somebody raised the pressure to take care of high end-point.

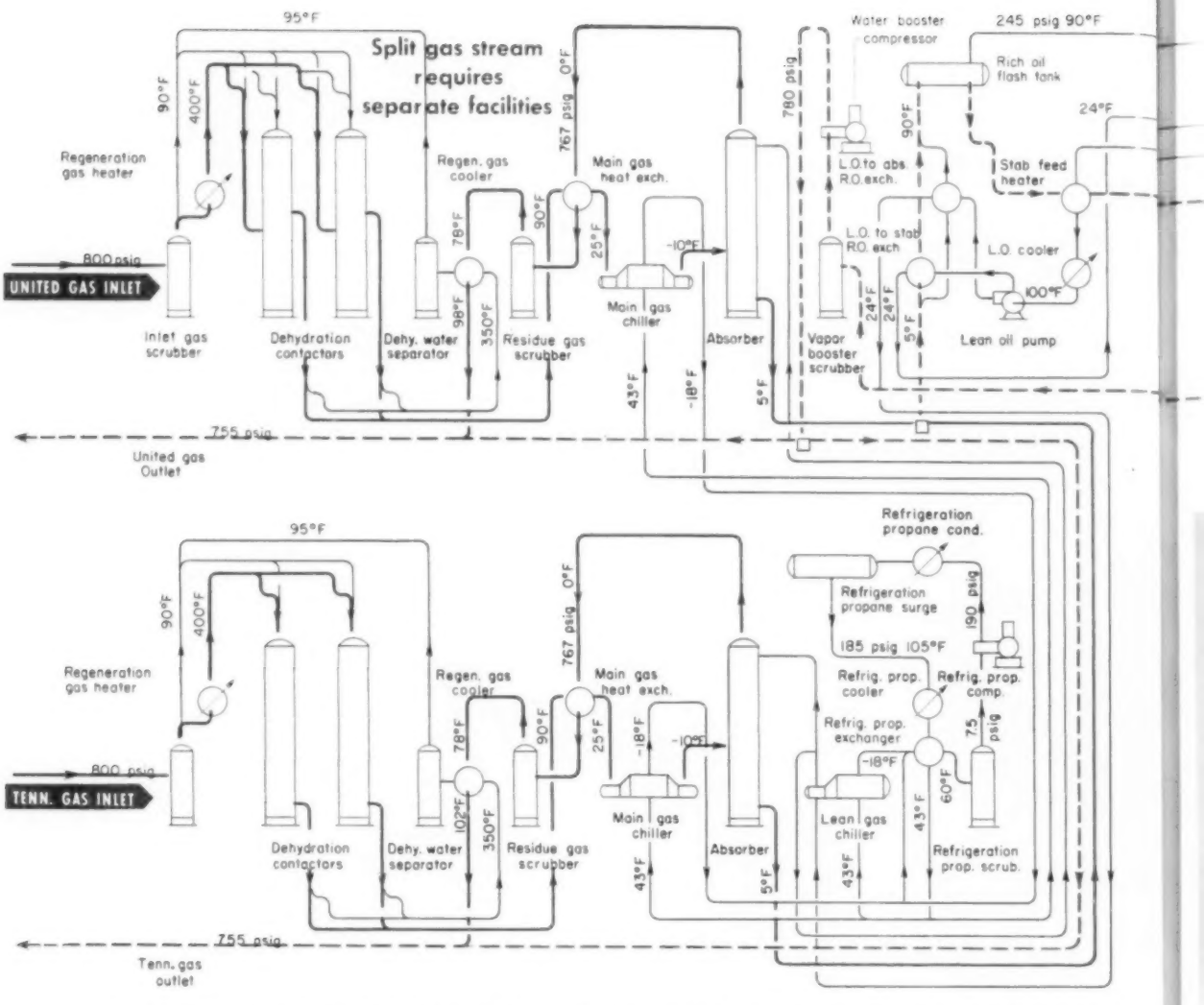
Allen (Phillips Petroleum Company): Don't you usually re-run the reformate on regenerative units running high octanes?

Wheeler: I think, in general, that's right. Particularly when you talk about high octane. In other words, they can stand a high end-point feed and they can run to high octane. So it is re-run to remove polymer. I think the selectivity of the low pressure operation is better and there is actually less polymer on a regenerative operation with a higher end-point feed.

Mr. Forter

Forter: We don't have a Platformer, but we do have a fluid hydroformer, as we call it. Our experience with higher end point naphthas has been just as it would be with a cat cracker and a heavier feed-stock. You're limited by your coke burning capacity in your regenerator as to how high you can go, feed-wise, if you want to maintain a given severity level.

The final section of the Q & A series will cover miscellaneous problems of petroleum processing, including treating



TWO COMPETELY SEPARATE SYSTEMS process gas containing less than 1 gal/mcf at the Red Fish plant.

"Marginal Operation" Pays Off

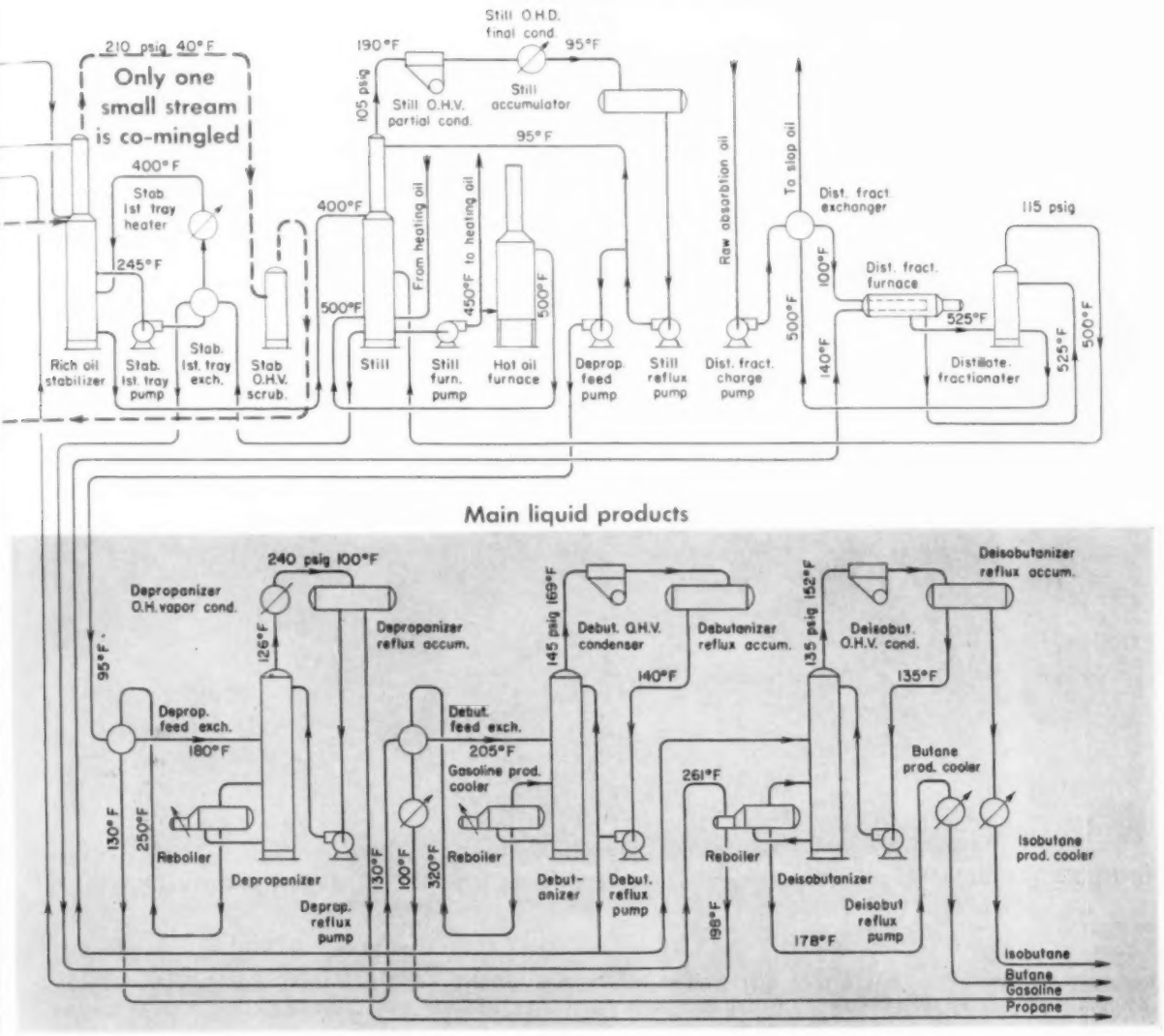
HOW DO YOU make a lean-gas operation profitable? Sunray Mid-continent thinks that at its Red Fish Bay Gas Products Plant near Corpus Christi, which operates on inlet gas with less than 1 gal/mcf, these factors made it possible:

- absorption at low temperature (−10°F)
- low fuel requirements (less than 1.3 vol-% of gas charged)
- low operating costs (two operators per shift)

By RON CANNON, Southwestern Editor

These factors are results of features that are not revolutionary, or even uncommon, but which may forecast the gas-products plant of the future as lean-gas operations become more attractive and/or necessary.

Built to supply dry sales gas and to recover gas liquids, the plant is a result of both necessity and opportunity. Gas from the Corpus Christi Bay fields is produced and owned by several companies. The plant is owned by Sunday Mid-Continent, Shell, Sinclair, Renwar, Tidewater, Atlantic, and Arkansas Fuel Oil. In contracting to supply gas to Tennessee Gas Transmission Co. and United Gas Co., the producers built the Red Fish Bay



The broken color line shows the only co-mingled stream, a very small one

In Trend-setting Lean-Gas Plant

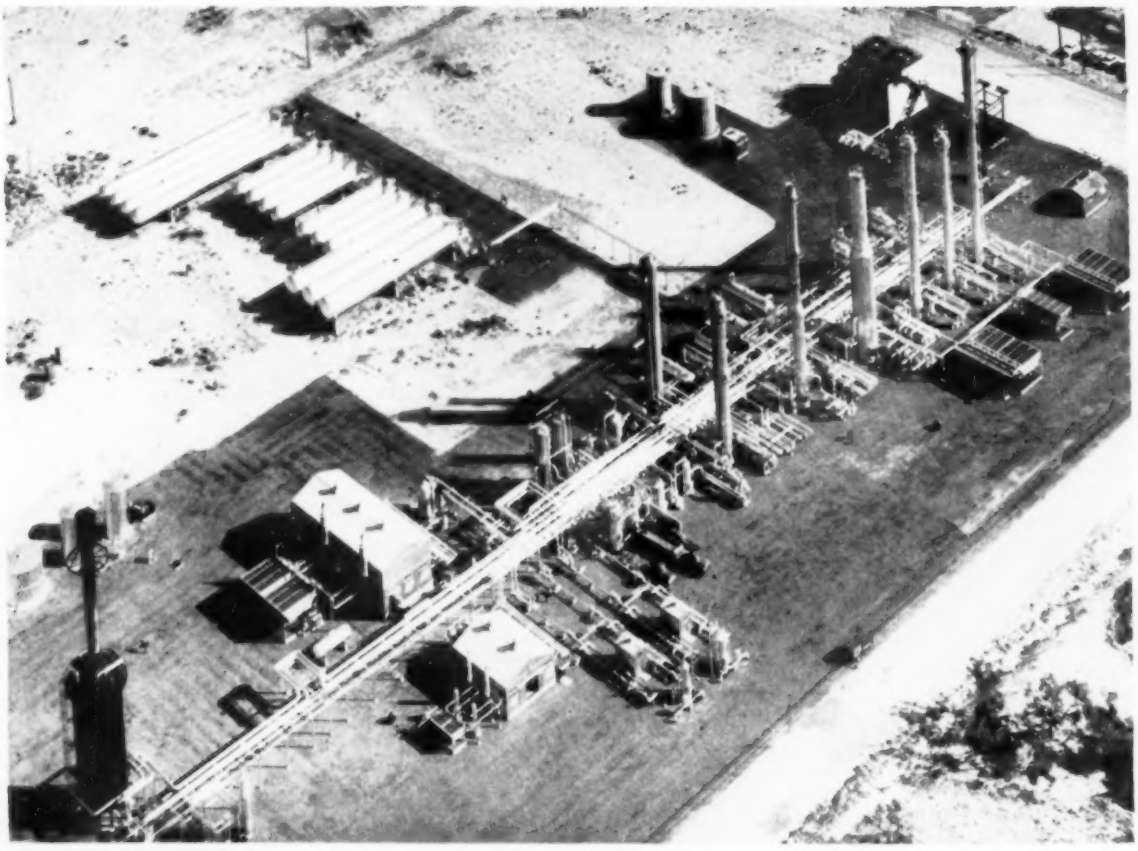
Plant as a joint venture to recover gas liquids before delivery.

Here's how the operation works: gas is gathered and processed through the plant in two completely separate systems—one for each customer. Dry sales gas is delivered at the plant outlet to the buyers. The gas liquids are separated in a common distillation and fractionation system. Income from products goes to each producer on the basis of gas delivered to the plant and tested liquids content.

The split gas streams necessarily require completely separated gas handling facilities. Thus, similar facilities are required for dehydration, gas chilling, and absorption. For United's gas, facilities are sized to handle 60,000 to 150,000 mscfd; on the Tennessee side, 24,000 to 70,000 mscfd. There is co-mingling of one very small gas stream from the overhead of the single rich-oil stabilizer. This gas is proportioned to sales gas to the two transmission companies on the basis of the percentage of charge gas in each system.

Inlet gas in both systems is chilled to $-10°F$ before absorption. In order to reduce refrigeration horsepower, gas from the dehydrators exchanges heat with the cold overhead from the absorbers.

The absorption oil cycle is a system common to both gas streams. Lean oil to the absorbers is chilled to $-10°F$ in a single chiller. One of the well-known advantages of low-



ONLY TWO OPERATORS run this lean-gas operation, now producing about 155,000 gal/d of products. The split gas stream requires separate absorbers which are shown near the center of the photo

temperature absorption is that it requires a much lower oil-circulation rate. At 100,000 mscfd, the oil rate to the United absorber is 314 gpm. At 40,000 mscfd it is 125 gpm to the Tennessee absorber.

Absorption takes place at 950 psi maximum. No compression is required because well-head pressure is about 2000 psi.

Rich oil from the two absorbers is combined and passed through a single rich-oil stabilizer. Overhead vapors from the stabilizer are used for plant fuel requirements with the excess recompressed to line pressure and combined with the sales gas leaving the plant.

The fractionation section is a straight-forward arrangement of still, depropanizer, debutanizer, and deisobutanizer, capable of recovering a minimum of 80% of the propane and 95% of the butane in a total gas charge of 140,000 mscfd.

Actual plant products at this time are 155,000 gal/d—marketed as a single blend of all the gas liquids from the still overhead. The remaining portion of the fractionation section is not in operation because the 110 RVP mixture is sold at the price of the components.

The refrigeration system, with propane as the refrigerant, consists of two stages of compression and water condensing. Liquid propane from the condenser exchanges heat with the propane vapor returning to the compressor. The system is designed to maintain a temperature of —18°F on the chillers, with the temperature being controlled by back pressure regulators. Total refrigeration horsepower is 1880 hp.

Fuel requirements for the Red Fish Bay Plant are less than half normally required for a conventional absorption process.

At 140,000 scfd, the fuel requirements are 1,790 mscfd, or less than 1.3% of the gas charged to the plant. Compared to about 4% fuel requirements for most hot absorption processes, and considering today's gas prices, it becomes an easy matter to show an appreciable savings in fuel costs.

Low fuel requirements are basically the result of the low oil rates possible with the cold process. Heat requirements for a greater oil rate will account for upwards of 60% of the fuel costs in a conventional hot absorption process. Although offset by the added cost of refrigeration in the low-temperature process, this does result in a net fuel saving.

Besides fuel savings found in the lowered absorption oil circulation rate, no steam is required for process heat. One hot-oil stream, heated by a single furnace, supplies all heat—including building heat—for the plant.

Operating costs are another bright spot in the economics of the Red Fish Bay Plant. Only two operators per shift are needed to run the plant. The maintenance crew is 6 to 7 men. They work days only.

Instrumentation, on first thought, is only part of the reason for low operating costs, though it might seem to be the major factor. Instrumentation is complete, but not extraordinary.

Probably the biggest contributing

FRACTIONATION SECTION in background shows difference in vessel sizing. United's absorber at left is scaled to handle up to 150,000 mscfd. Tennessee's absorber, next to it, is scaled for up to 70,000 mscfd

factor is the flexibility of operations possible with the process. Absorber temperatures, say Sunray field people, are not critical, and they can see no appreciable changes in operations from —10 to 0° F. Instrumentation is such that the refrigeration cycle is virtually automatic and requires little or no attention to maintain whatever temperature is desired. Weather changes —sometimes an upsetting factor in other plants—have no effect on either the absorption or refrigeration cycles, and are not a factor in this operation.

Start-up went smoothly

The Red Fish Bay Plant was designed and built by Dresser Engineering Co. of Tulsa, and began initial operation in mid 1956. Surprisingly enough, there was little trouble with freeze-ups while the plant was going on-stream.

In the start-up and drying-out procedure, dry gas was blown through the system and the temperature lowered very slowly. As the system cooled, water draw-offs were opened throughout the system to allow condensed moisture to drain. Methanol injection was provided in the refrigeration system until design temperature was reached. No further methanol was required.

In less than two days, according to plant personnel, the plant was in full production—something of a very pleasant surprise to all concerned, especially considering that the entire system had been hydrostatically tested and flushed with water.

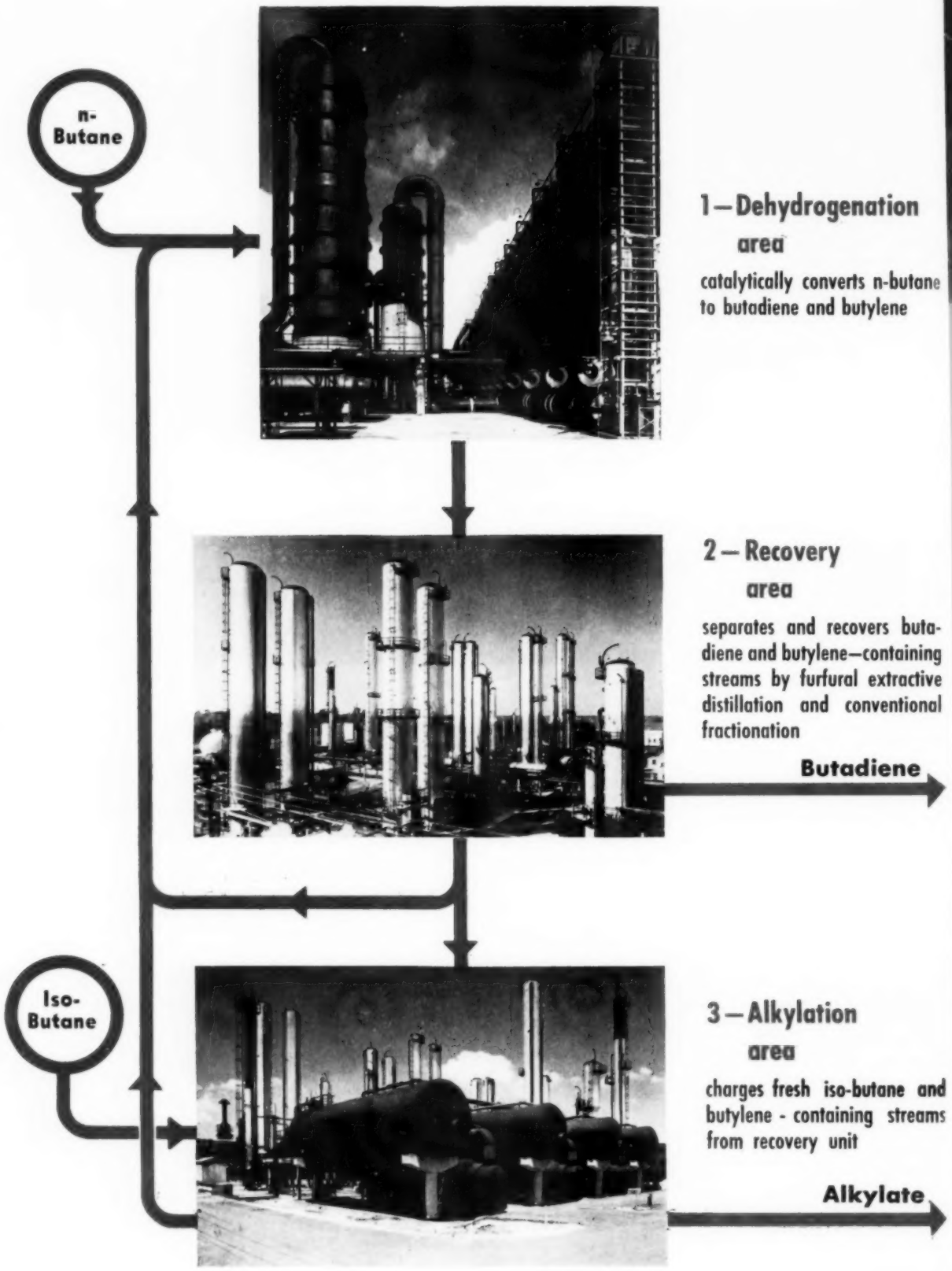
Operating troubles have been very minor to date. A switch in desiccant in the dehydrators was necessary, because of excessive attrition of the original material.

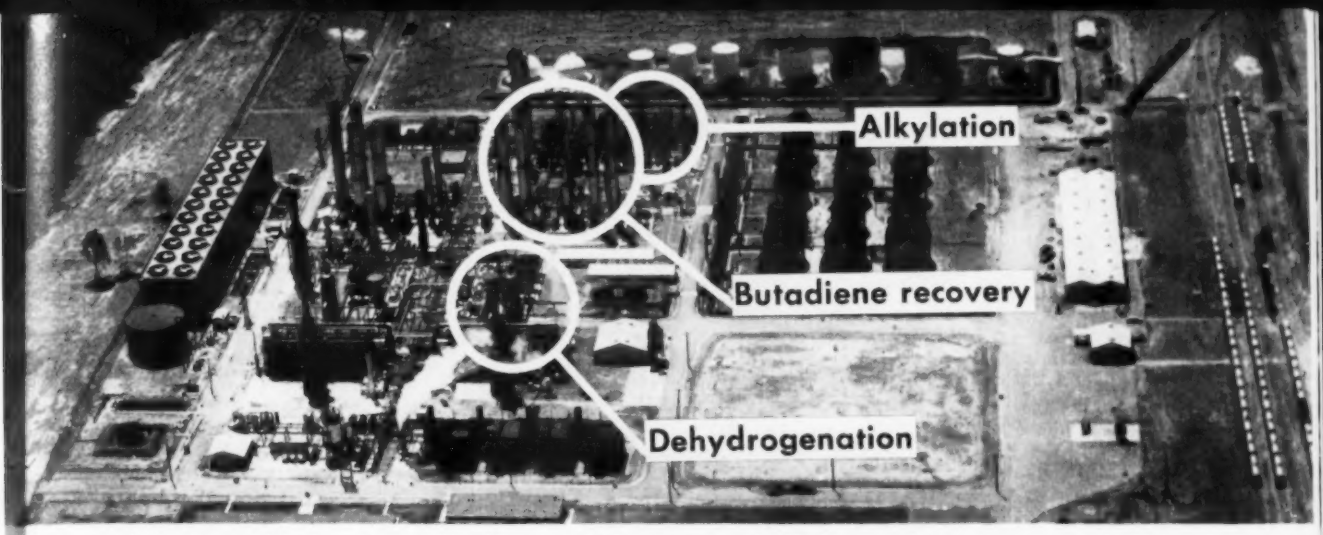
As originally built, propane to the chillers was controlled by a level controller—this resulted in rapid and undesirable fluctuations in liquid level. Changing to control by a differential pressure cell corrected this trouble very quickly.

The operation at present is so smooth that Sunray field people say that their biggest headache is the bookkeeping. Although the major gas streams are completely separated, there remains the problem of distributing products to the various owners.

Going after less than 1 gal/mcf can be a risky business. Whatever the reason—necessity, opportunity, or both—the process must be efficient and economical to operate. Most designers and operators agree that, depending on conditions, the gallon mark is somewhere around the break-even point. Some of the conditions that might influence the exact dividing line, of course, are such factors as field pressure, life of gas reserves, gas prices, and product prices.

In any event, it takes a great deal of nerve to point to any one factor that makes low-temperature absorption more economical than another process on a given gas. There are too many influencing factors. Certainly fuel savings is an important plus. Low operating costs are not restricted to any one process, of course, but Sunray's experience with this plant indicates that low temperatures might also be taken to mean low costs.


n-
Butane
1—Dehydrogenation
area
catalytically converts n-butane to butadiene and butylene
2—Recovery
area
separates and recovers butadiene and butylene—containing streams by furfural extractive distillation and conventional fractionation
Butadiene
Iso-
Butane
3—Alkylation
area
charges fresh iso-butane and butylene - containing streams from recovery unit
Alkylate



CIRCLED ABOVE are the three basic areas of TB&C's new privately financed $30-million installation

Butadiene Plant Makes Big News

THE first butadiene plant built since World War II has gone on-stream. The plant, owned and operated by the Texas Butadiene & Chemical Corporation of Houston, Texas, is also the nation's first privately-financed butadiene plant. The $30-million installation designated the Lyondell Plant of TB&C, is located some 15 miles east of Houston, on the San Jacinto River.

Designed and built by The Fluor Corporation, Ltd., the plant is characterized by extremely flexible and efficient operation. A unique dual-purpose design provides for both high-volume production of butadiene, and avgas alkylate, when butadiene, product is cut back. Starting with n-butane and iso-butane as raw material feeds, the plant is designed for the following yields, depending on the mode of operation:

1—When operating for butadiene alone, the plant will produce 86,000 t/yr of commercial grade butadiene.

2—While operating for *both* butadiene and alkylate, the plant can produce 64,800 t/yr of butadiene and 2.5-million b/yr of high-octane avgas.

The processing area is divided into three basic areas:

Dehydrogenation area, licensed by the Houdry Process Corporation, catalytically converts n-butane to butadiene and butylenes.

Recovery area, licensed by the Phillips Petroleum Company, separates and recovers butadiene and the butylene-containing streams by furfural extractive distillation as well as conventional fractionation.

Alkylation area, licensed jointly by Stratford Engineering Corp. and Texaco Development Corp. is a sulfuric-acid alkylation unit using the Stratford effluent-refrigeration principle. This portion of the plant charges fresh iso-butane and butylene-containing streams from the recovery unit. Unit effluent is fractionated to yield a light avgas alkylate and a motor-gasoline alkylate.

The three processes employed by TB&C have all been used individually before and all have been in commercial operation. However, this application is the first to combine the processes into one operating unit to produce two such diverse products as butadiene and aviation gasoline.

The chart opposite shows how they operate together: the first step is, of course, dehydrogenation of n-butane. Products from this area are fed to the recovery area. The first step in recovery is separation of butane and heavier hydrocarbons from the butadiene by conventional distillation. The butadiene fraction is further processed in the furfural extractive-distillation units, then redistilled to rubber-grade butadiene.

The unreacted butanes and butylenes remaining after separation of butadiene can then be recycled to the dehydrogenation unit, or they can be charged to the alkylation unit. The choice that may be exercised at this point gives the plant its unique flexibility. About half of the butylene stream will normally go into the alkylation unit as charge stock.

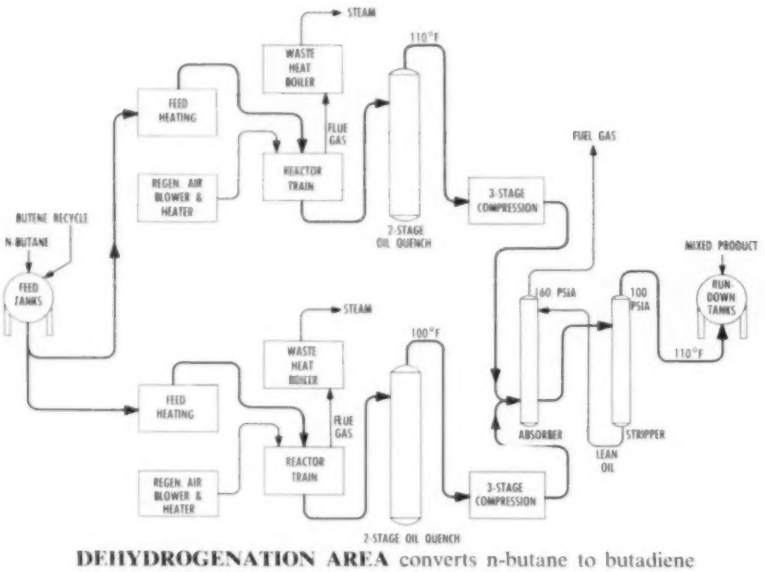
Butylene feed to the alkylation unit is reacted with an outside source of iso-butane to make the plant's production of alkylate. Iso-pentane is also brought in for final blending of alkylate into motor fuels.

The TB&C plant operation differs from other commercial installations of these processes on two major points: 1—the only other commercial Houdry dehydrogenation unit in operation is currently being used primarily to produce butylenes, whereas the TB&C installation is operated specifically to produce both finished butadiene and butylenes for alkylate feed stock; 2—other operating furfural extractive-distillation units are in use to separate butane from butylenes and to separate butylenes from butadiene, but the TB&C unit is designed and operated to separate butadiene from a mixture of butane, butylenes, and butadiene.

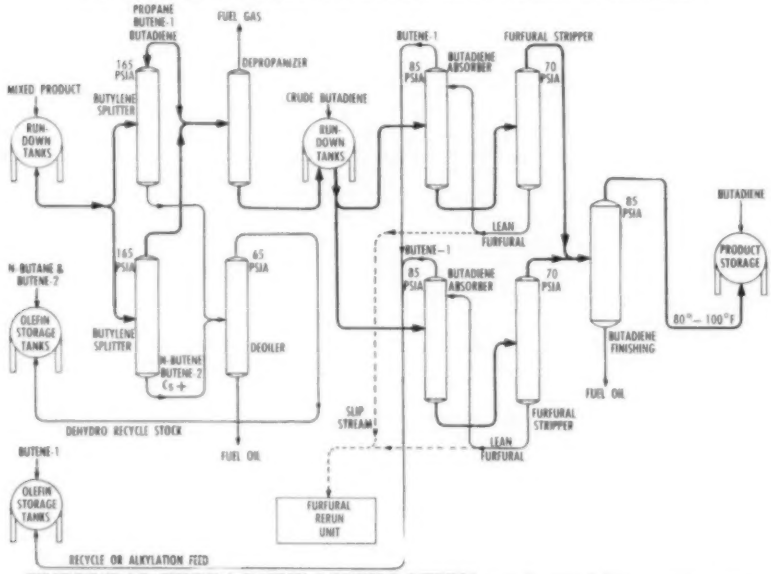
Dehydrogenation Area

The Houdry dehydrogenation area includes equipment for preheating and dehydrogenating the n-butane feed, for quenching and compressing the effluent reaction gas, and for regenerating the catalyst. The associated vapor-recovery unit contains equipment for removal of by-product light ends by means of an absorber-stripper cycle. Because of large equipment sizes involved, and to provide operational flexibility, a portion of this area is split into two identical parallel process trains as shown in the dehydrogenation-area flow diagram.

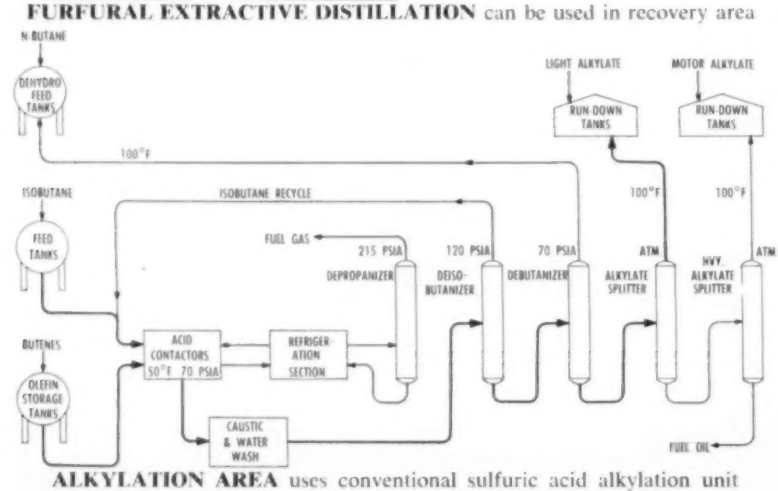
Fresh butane feed is combined with



DEHYDROGENATION AREA converts n-butane to butadiene



FURFURAL EXTRACTIVE DISTILLATION can be used in recovery area



ALKYLATION AREA uses conventional sulfuric acid alkylation unit

recycle butylene, vaporized with hot oil, and super-heated in fired heaters to reaction temperature. The heated feed vapors then flow at 3.5 psia through the reactors, where the dehydrogenation reaction occurs. Reaction effluent gas is immediately quenched in direct contact quench towers before going to the product compressors.

The compressed vapors—containing butadiene, butylenes, unreacted butane, hydrogen, light hydrocarbons, and small amounts of impurities—are then processed in a conventional absorber-stripper cycle employing naphtha as absorption oil. The absorber is designed to recover a portion of the propane and all of the butane, butenes, butadiene, and heavier components. Rich oil then goes to the stripper for removal and condensation of the mixed product.

Reactors: Each reactor train contains seven reactors, which are horizontal, refractory-lined vessels containing a bed of Houdry chrome oxide-alumina catalyst. Coke is deposited on the catalyst during reaction and is subsequently removed by combustion with air during regeneration. Before regeneration, the reactors are purged and evacuated.

Hot flue gases from the regeneration operation flow through waste heat boilers, which generate about 240,000 lb/hr of 250 psig steam.

After regeneration, reactors are evacuated and purged to remove residual oxygen before re-introducing feed hydrocarbons. Three reactors are on stream, three reactors are on regeneration, and one reactor is on purge, evacuation, or valve change at any given instant. A master cycle timer, actuating hydraulically operated valves, controls the cycle for each reactor train.

Cycle timer: The master cycle timer for each reactor train is basically the "brain" of the dehydrogenation unit. The timer controls the cyclic process and safeguards the unit against maloperation. Not only does the timer send the electrical impulses to start opening and closing of reactor valves, but it checks in subsequent steps whether or not the valves have actually moved to their correct position. During certain phases of the cycle, the timer also checks the pressure in the reactor to determine if it is safe to proceed to the next phase. Should a timer check fail to be satisfied, the timer automatically stops and sounds an alarm. At the same time, an electrical brake keeps the timer from "coasting" to the next point.

Another system of interlocks—independent of the cycle timer test

circuits—prevents the opening of any individual valve unless the other valves on that reactor are in a safe position for that phase of operation.

Valving system and hydraulic system: Each reactor has seven valves. Three of these valves are 30-in.—among the largest ever made for high temperature service—for air inlet, air outlet, and product outlet.

Reactor valves are used with volatile gases at very high temperatures—leakage is a hazard. As a safety precaution, these valves are designed so that when the valve is closed, inert gas seals off the interior of the valve and prevents air-hydrocarbon mixing.

The dehydrogenation unit uses a hydraulic power system for opening and closing the reactor valves upon receiving an electrical impulse from the cycle timer. This is the first commercial application of a central hydraulic system in a petrochemical process of this scope and is very probably one of the largest commercial applications of hydraulic power for an operational control system.

System pressure is maintained by sliding-vane rotary pumps. To compensate for intermittent demands and for varying hydraulic power requirements, each reactor control panel has an hydraulic oil accumulator that "stores" oil during low-demand periods and then releases it during high-demand periods.

Hydraulic oil-flow controllers control oil flow during both opening and closing strokes in order to meet the time alloted each valve motion on the cycle timer. Also, to prevent slamming a valve shut too tightly, a pressure reducer cuts the oil flow for the closing stroke to a much lower pressure than is used for the opening-stroke oil flow. Each hydraulic piston cylinder has an "hydraulic cushion" in it that cushions the last fraction of any stroke as an added precaution against slamming.

Butadiene recovery area

The butadiene recovery area contains equipment for separating product butadiene from dehydrogenation reactor effluent—a mixture of butane, butenes, and residual light ends. The mixture is fractionated to split the butadiene and lighter components from the butane and heavier components.

From the butylene splitter: overhead is depropanized and crude butadiene and butene-1 are pumped to run-down tanks; bottoms (butane and butene-2) are deoiled of heavy ends, pumped to storage and used as recycle to the dehydrogenation area.

Crude butadiene and butene-1 are further separated by extractive distillation using furfural as a selective solvent for butadiene. The butadiene absorber overhead stream of butene-1 is sent to storage for use as either recycle to the dehydrogenation area or as feed to the alkylation unit.

Again, because of equipment sizes, portions of the recovery area are split into parallel trains.This not only provides operating flexibility but, combined with the parallel dehydrogenation reactor trains, allows staggered shut-downs for catalyst changes.

Alkylation Area

This area contains equipment to react the butane-butene streams from the recovery area with fresh iso-butane feed and to separate the reaction products into an internal iso-butane recycle stream, normal butane for recycle to the dehydrogenation area, a light alkylate product, and a motor alkylate product.

The area illustrated by the last flow diagram, is a conventional sulfuric-acid alkylation plant with effluent refrigeration. It includes four parallel contactors designed to allow operation of all or part of the contactors. One design innovation is the combination of the usual compressor suction dry drum with the refrigerant flash drum into a single vessel. Another innovation uses the liquid refrigerant stream to cool the flow of compressor anti-surge gas by direct contact and heat transfer, resulting in a system that can be "blocked in" and put on recycle for indefinite periods.

A conventional fractionation train of four columns splits the reaction effluent into an internal iso-butane recycle, n-butane for recycle to the dehydrogenation area, and into the two product alkylate streams. The 335° F end-point light alkylate is blended with iso-pentane, leaded with TEL, and marketed as 115/145 aviation gasoline. The 400° F end-point heavy alkylate is marketed as a motor-gasoline blending component.

Facilities

Process control: The TB&C plant was designed for maximum use of onstream analyzers and some of the latest developments in process control instrumentation are being used. Nine different onstream analyzers—ultra-violet, infra-red, and chromatog—keep a constant watch on streams in the process.

These process control instruments enable TB&C to operate the plant with remarkable precision at high capacity. It is estimated that these controls provide a 15% increase in plant capacity while maintaining the same product purity.

Plant site storage includes 139,000 bbl of LPG storage spheres for butane, iso-butane, butenes, crude butadiene, and product butadiene. Avgas rundown, blending, and product storage includes 10,000 bbl of spheroid tankage, 60,000 bbl of floating-roof and 20,000 bbl of cone-roof tankage. Off-site wells hold 1.5-million bbl.

Plant utilities: In addition to the 240,000 lb/hr of 250-psig steam generated in waste heat boilers in the dehydrogenation area, the plant has four 600-psig, steam-generating units rated at a total of about 1,000,000 lb/hr.

Cooling water is circulated through an 11-cell, induced-draft cooling tower rated at 116,000 gpm of circulation at an overall Δ T of 23° F.

About 25% of the plant fuel-gas requirements are supplied by off-gas streams from the processing units; the remainder from outside sources.

Raw material requirements: Texas Butadiene's raw material needs make it the world's largest consumer of LPG for chemical use, emphasizing the trend toward increasing use of these plentiful hydrocarbons for petrochemicals. Normal requirements for capacity production of both butadiene and alkylate are roughly 10,000 b/d of normal butane, 4,300 b/d of iso-butane, and 1,500 b/d of iso-pentane. The latter material is used for blending with alkylate to make finished gasolines.

Adapted from "The Nation's First Post-War Butadiene Plant," by W. J. Brack of Texas Butadiene & Chemical Corp., and M.R. Beychok of the Fluor Corp., Ltd.

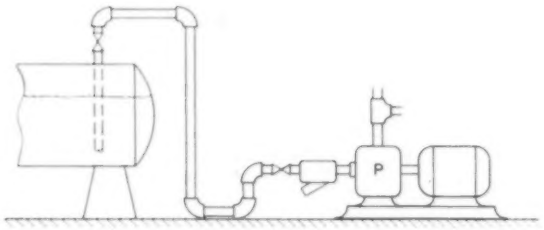
About TB & C

Texas Butadiene & Chemical Corporation was incorporated in the State of Delaware on July 2, 1954. The original plant concept and evaluation of economic feasibility was initiated by Dr. Robert L. Purvin, of Purvin & Gertz, Inc., Dallas, Texas. After initial evaluation, and after financial backing was obtained, the Fluor Corporation was commissioned to design and build.

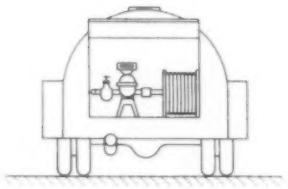
Construction started in the fall of 1955, and the last operating portion of the plant was turned over to TB&C personnel in February, 1957. The plant was in full production by March.

How to Meter

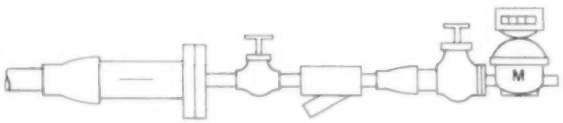
Four causes of vaporization in volatile-liquid systems



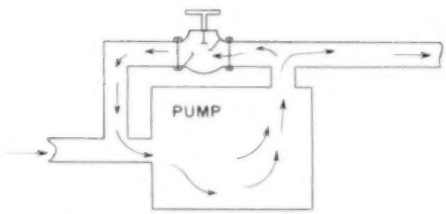
1—PUMP STARVING. Indirect, small lines. Unnecessary fittings. Pump inlet too high relative to tank. Insufficient supply of liquid to pump, reduces pressure.



3—TOO MUCH HEAT. Meter and piping too close to exhaust pipe or vehicle muffler. Higher temperature causes vapor formation.

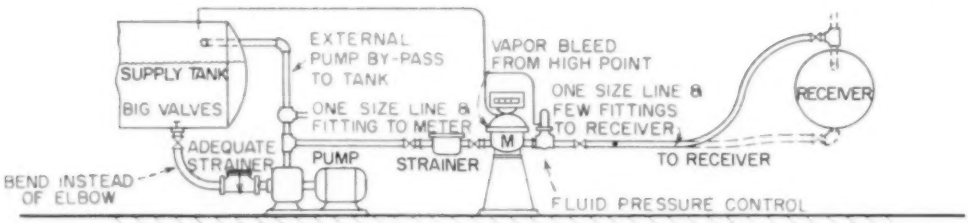


2—FLOW RESTRICTIONS. Too many different sizes of pipe and fittings. Changes in pipe sizes cause pressure drop and vapor formation.



4—UNNECESSARY AGITATION. A built-in by-pass on pump creates heat because of continuously circulated liquid: result, vapor formation.

Six rules for a correct metering installation



1—Place the pump at a lower level than the supply tank and as close to the tank as possible.

2—Keep piping from tank to pump, including fittings, as large as practical—at least one size bigger than pump discharge pipe. Keep fittings to a minimum. Mesh in strainer — if used — must be large enough so that clogging will not starve pump.

3—Pump by-pass — if used — must not flow from pump outlet. Rather, it should flow to supply tank — and preferably to vapor space of tank but in any case well away from tank outlet to the pump.

4—Don't use pipe and fittings of varying sizes from pump to meter. Aim at minimizing pressure drop. The arrangement should not permit pockets where vapor can accumulate during idle time. High point in the line should be in meter itself ahead of measuring mechanism or in a suitable vapor eliminator directly upstream of the meter. Any vapor formed can then flow directly back to supply tank vapor space.

5—Install a device as closely as possible to meter outlet to prevent flow through the meter until pressure therein is substantially greater than the fluid's vapor pressure. A spring-loaded valve will serve under some conditions, but a spring-loaded differential valve is preferred generally.

6—Size the piping or hose and fittings leading from differential valve to receiver to prevent vapor formation in the stream.

Highly Volatile Liquids

By GEORGE E. BATCHELDER
Rockwell Mfg. Co.

ANYONE who has tried to meter liquefied propane, anhydrous ammonia, carbon dioxide, oxygen and similar materials will be well aware of the problems involved. Under slight increases in temperature or reductions in pressure, these highly volatile liquids tend to vaporize.

For accurate flow measurements, the tendency to vaporization must be overcome. Gas passing through the meter will not only cause false reading but may actually damage the meter by overspeeding.

Vapor can form in several ways. The four shown in the diagram are the most common: pump starving, flow restrictions, too much heat, and unnecessary agitation.

To prevent vaporization and insure correct metering, certain rules must be followed when the meter is installed. Six essentials for a correct installation are shown below, left.

The spring-loaded valve mentioned in Rule 5 is recommended because:

The flow meter discharges to the inlet of this valve, which is normally closed. Force exerted by vapor pressure on one side of the diaphragm tends to keep the valve closed. This vapor pressure is obtained by connecting the diaphragm chamber to the supply tank vapor space. The adjustable spring also tends to hold the valve closed.

Pressure of the fluid in the meter —applied to the opposite side of the diaphragm—tends to hold the valve open. Vapor pressure of the liquid in the meter will balance that from the supply tank; consequently the valve cannot open until the pressure in the meter exceeds the vapor pressure by enough to counteract the force exerted by the spring. The spring is usually adjusted so that the excess pressure required is about 15 psi, which the pump supplies.

As a result, all fluid between the pump and the differential valve is kept under enough pressure as to keep it in the liquid state, a condition essential for correct metering.

Delivery to receivers

Highly voltatile liquids, metered through the above type of system, may be delivered to either closed receivers or to receivers equipped with a pressure relief.

Whatever fluid enters a closed receiver must remain in it, and the amount added should be that shown on the meter. This is an ideal result but there are several drawbacks to its accomplishment.

Most receiving tanks now in use have the entering stream in or near the bottom of the tank. Assuming the usual condition—some liquid and some vapor in the receiver when the fill is started, the pressure in the receiver is equal to the vapor pressure at whatever temperature may exist in the receiver. If the temperature and vapor pressures of the liquid in the receiver and the incoming liquid are the same, the incoming liquid under pump pressure will compress and liquefy the vapor in the receiver.

However, ideal conditions seldom exist. The temperature in the receiver may frequently create pressures that tax the ability of the pump, slowing and sometimes stalling it. The rising liquid creates heat of compression and increases vapor pressure. To reduce the pressure, heat must be dissipated through the shell of the receiver. If heat generation is faster than dissipation, pressure will increase to a point at which it is impossible for more liquid to enter. Such conditions cause slow or intermittent operation. They also cause inaccurate metering because the meter is slowed to a rate below its minimum for correct measurement.

One method to alleviate such troublesome conditions is top or spray fill. The receiver is filled from the top, the stream breaking into spray upon entering. Sometimes a spray-forming nozzle is used to insure better spray effect. Less temperature and pressure change is caused in the receiver through use of this method, it is said. Satisfactory results can be obtained when surrounding conditions are favorable. However, with either bottom or top filling methods, conditions often cause pressure difficulties; therefore, systems using a vapor return line are quite generally used.

Use of vapor return line

In systems using the vapor return line, the vapor spaces of the receiver and supply tank are connected by suitable piping. Pressures in the two are equalized and the pump can push liquid through at a rapid and constant rate. But this, too, has its drawbacks.

In a perfectly balanced operation, vapor originally in the receiver will be displaced by incoming liquid and returned to supply. Because this vapor may be of substantial value, an adjustment must be made between seller and buyer.

An unbalanced operation is usually caused by the temperature of the receiver being higher than that of the supply tank. Some liquid will vaporize and the vapor will, because of its higher pressure, pass to the supply tank. Incoming liquid will also vaporize on entering the warmer vessel and this vapor will flow to the supply tank until such time as the pressures are equalized. Under such conditions the actual volume of liquid remaining in the receiver after completion of delivery is indeterminate. Vapor may flow from supply to receiver, though this is unusual.

The conversion of liquid to vapor and its return to the supply tank results in less liquid remaining in the receiver than the meter shows was delivered. Such discrepancies often amount to a considerable percentage, even though all working components of the system, including the meter, are in perfect order.

The return vapor line method allows rapid but possibly inaccurate deliveries. The tight fill method permits accurate deliveries if the flow rate is kept above the minimum rated capacity of the meter. However, it can be time-consuming and, therefore, costly to the supplier by tying up equipment and labor. Because the return vapor line does not assure correct delivery, some people are urging its use be outlawed in metered deliveries of certain liquids from seller to buyer.

Two-differential system can solve problem

A system has been developed that proved very satisfactory for metered transfer of LPG and anhydrous ammonia, and is also applicable to other low boiling point liquids. Basically this system—developed by Rockwell Mfg. Co.—is the same as one using a vapor return line, except that a second differential valve is placed in the vapor return line. This valve is adjusted to require a definite increase in vapor pressure in the receiver over

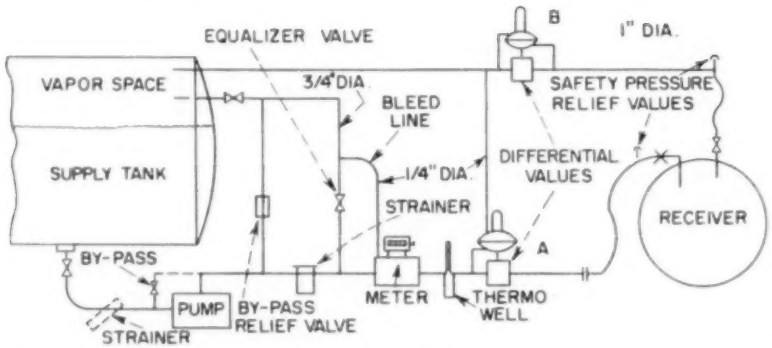


Fig. 1—**TWO-DIFFERENTIAL SYSTEMS** for metered transfer of volatiles

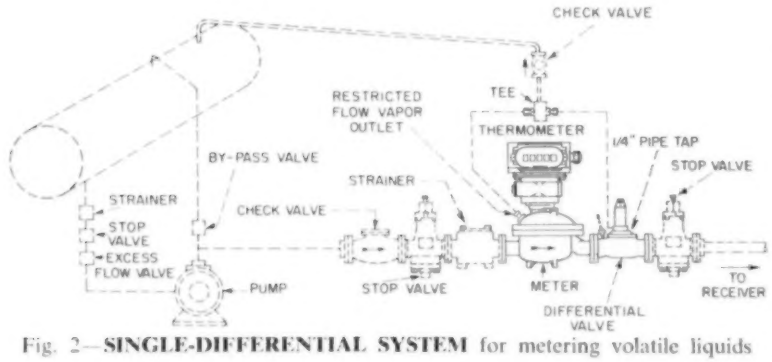


Fig. 2—**SINGLE-DIFFERENTIAL SYSTEM** for metering volatile liquids

that in the supply before vapor can flow to the supply tank.

As a result, practically the same conditions are imposed on the receiver as on the system between the pump and the first differential valve.

The second differential does not positively prevent the passage of vapor, but by imposing a definite back pressure on the receiver, the "flashing" or vaporization of liquid in or entering the receiver is prevented. It has been repeatedly demonstrated that, under the same operating conditions, the use of this valve reduced the apparent metering error from 4% to 0.3%, an acceptable tolerance.

In addition to the second differential valve, certain piping arrangements are included in this system with the object of keeping the pump and meter liquid filled at all times, thus preventing "vapor lock" often found when starting the pump, and the trapping of vapor in or ahead of the meter.

The use of a single differential valve downstream of the meter is common practice—this is known as the Parkhill-Wade system. The use of a second differential valve in the vapor return line is termed the "Dual Differential System," on which an application for patent was filed by Rockwell Mfg. Co.

Although differential valves are preferable under normal operating conditions, spring-loaded check valves will satisfy under closely controlled operating conditions. Such conditions sometimes exist during transfer of low temperature liquids such as oxygen or CO_2, where the entire system including the receiver is brought to a definite temperature, (and vapor pressure) before starting delivery and maintained at the same temperature during delivery.

A diagrammatic arrangement of the Dual Differential system is shown in Fig. 1. The installation reflects the rules set fortth for metering volatile liquids.

The pump is placed below the outlet of the supply tank. The piping to it is as large as practical (at least larger than that on the outlet end) and as free of fittings as possible. The strainer has a mesh large enough so that clogging will not tend to starve the pump.

The by-pass is required only with positive displacement pumps. Open during idle periods, it will insure liquids being in both sides of the pump.

The pump pressure relief by-pass is external to the pump and the return delivers through the by-pass relief valve to the vapor space in the supply tank. This return line is kept separate from the dry-vapor return line from the receiver and the upper differential Valve (B).

Downstream of the pump by-pass return line is the usual strainer protecting the meter. Between this strainer and the meter, another line connects to the by-pass return valve, which is left slightly open when the system is not operating and closed immediately after starting the pump. Into this line and above the equalizer valve, a bleed line is connected from a small orifice in the meter, upstream of the measuring chamber.

During idle periods with the equalizer valve open, liquid from the supply tank will flood the system as far as the lower differential valve (A), reaching its level in the pipe. Vapors that may form in the meter will bleed off through the bleed line. Thus, the system will be liquid-full and ready for operation, without entrapped vapors at all times.

Differential Valve (A) functions here as it does in the Parkhill-Wade system, described below. The insertion of a second differential valve (B) in the vapor return line imposes practically the same conditions upon the receiver that differential valve (A) imposes on the meter and line ahead of it.

The pressure of the vapor from the receiver must be substantially greater than the normal vapor pressure, as in the supply tank, before valve (B) will open. Under usual conditions, vapor initially in the receiver will be condensed to liquid and flashing of incoming liquid is prevented.

The second differential acts as a relief valve, too. Should the pressure in the receiver become great enough to cause it to open, there will be an immediate pressure reduction in the receiver, with a consequent cooling of the vapor in the receiver and still further pressure reduction. Therefore, the differential valve (B) will quickly close again, having passed only a negligible amount of vapor.

A thermo well should be provided —in, directly head of, or after—the meter so temperature corrections can be made. A safety relief valve (or valves) should be installed wherever high liquid or vapor pressures might be created by atmospheric heat during idle periods.

This Dual Differential system will give good results with all low boiling point liquids. Top filling of the receiver is preferable, although bottom fill—usually in existing receivers—can be used. Under closely controlled

operating conditions, spring-loaded check valves may be used instead of the differential valves. It is, of course, essential that all equipment be carefully selected for its suitability to the product, conditioins of operation, and compliance with legal requirements.

Single differential system

A diagrammatic arrangement of a single differential, or Parkhill-Wade, system is shown in Fig. 2. Less involved that the dual differential system, it insures protection of the meter against the passage of vapor, and the meter will correctly register the amount passing through it.

No receiver is shown in the diagram; the receiver may be either closed or provided with a vapor return line. In either case, the receiver difficulties previously mentioned may be encountered.

Acceptable results can be obtained, however, with liquids at subnormal temperatures, when temperatures and pressures are controlled. Under such conditions it is possible to use a spring-loaded check valve in place of the differential valve.

If a return vapor line is used, the piping above the check valve shown over the meter can be connected to it. If a spring-loaded check valve is used there will, of course, be no need of tubing from it, or the "tee" fitting.

It is always best to keep the pump and meter liquid full at all times; however, it may occasionally be necessary to start a flow through a dry meter. It is then essential that overspeeding of the meter be prevented and that the system from the storage tank to the meter is liquid-full before starting a metered flow.

With liquids handled at atmospheric temperatures this can be done by cracking the valve lightly at the end of the discharge line before connecting this line to the receiver—then closing it when clean liquid appears.

When liquids at sub-normal temperatures, such as CO_2 and oxygen are handled, some time may be required to cool the equipment enough to establish a temperature balance. Such cooling of the system can be accomplished effectively by running a small line from the bottom of the meter back to the supply tank. The connection to the meter should be at some point ahead of the measuring mechanism. There is a stop valve in this line and a test valve also, set closely under the meter, which when opened discharges to the atmosphere.

Meet the author

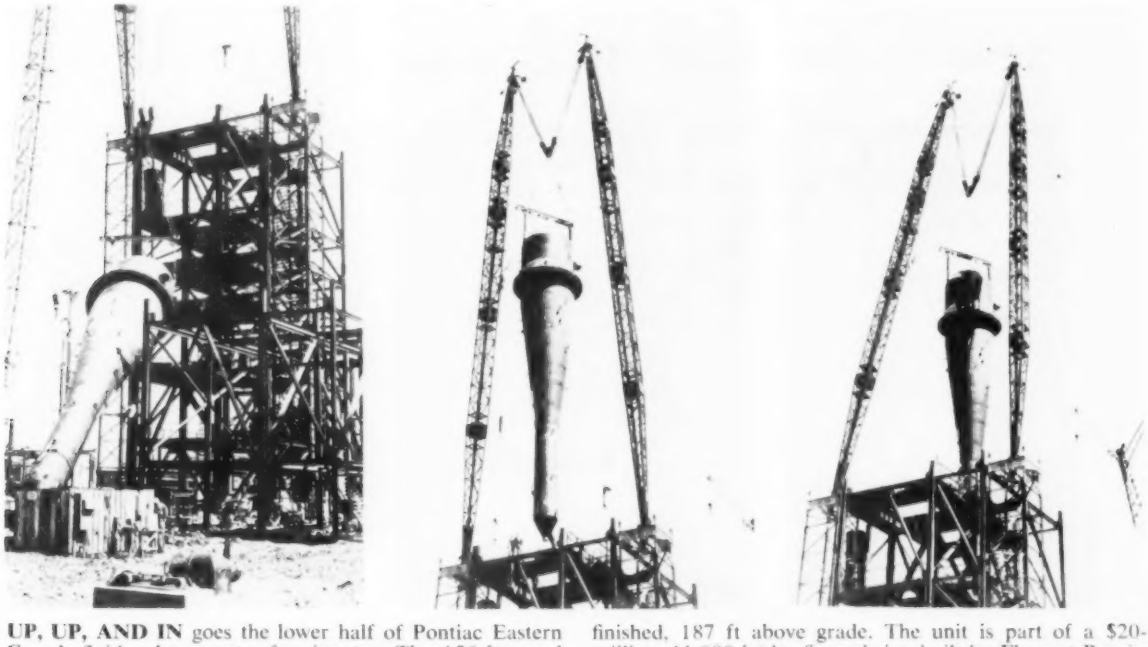
Mr. Batchelder

George E. Batchelder is project engineer, Central Liquid Meter and Register Engrg. Dept., Rockwell Mfg. Co., Pittsburgh. A native of Lowell, Mass., he joined the company in 1935 as a design engineer for the Nordstrom Valve Division at Oakland, Calif. In 1944 he moved to his present position.

Before going with Rockwell, Mr. Batchelder spent three years in construction work in southwestern oil fields and seven years in engineering for Standard Oil Co. of California.

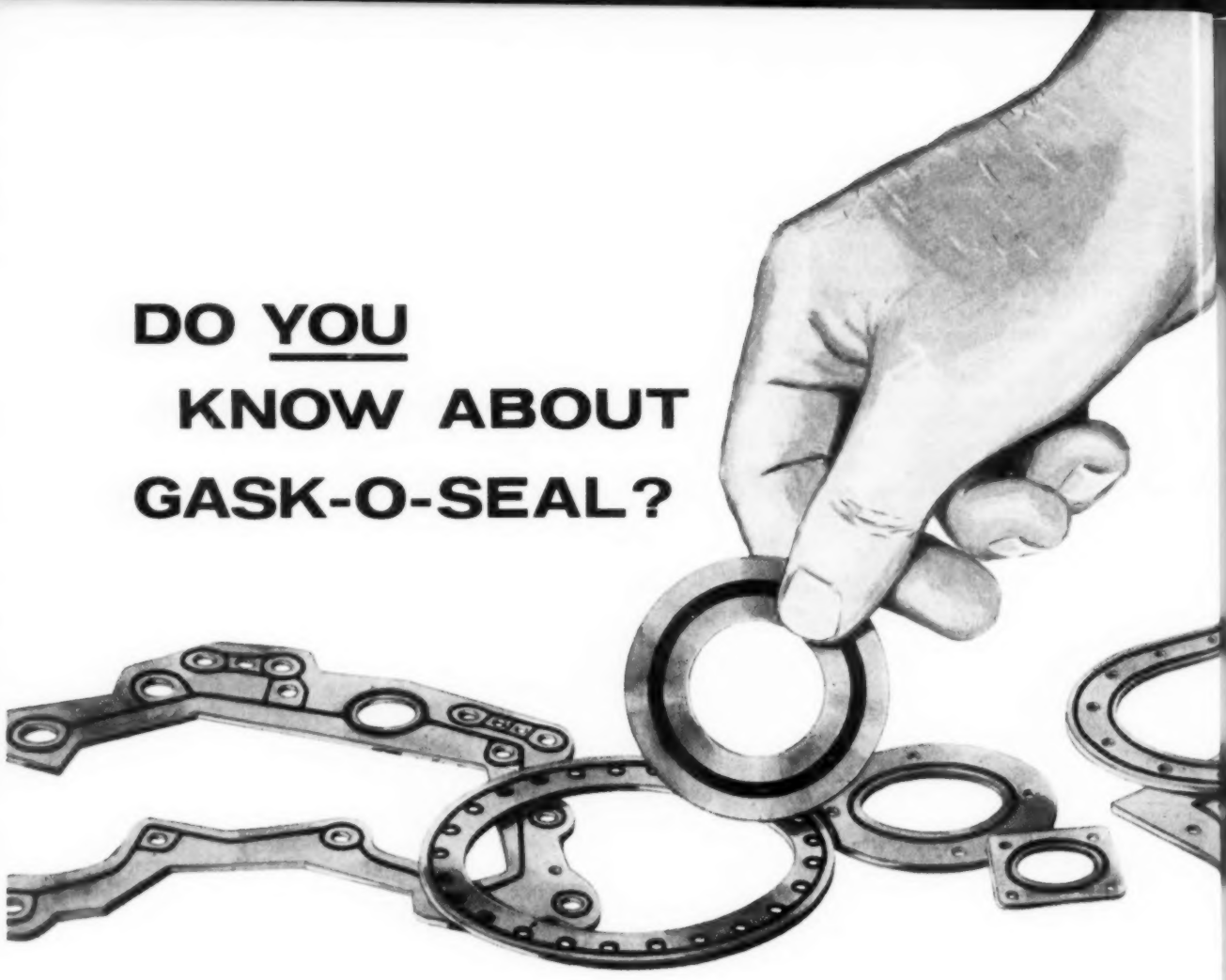
A member of the Technical and Standards Committees of the Liquefied Petroleum Gas Assn. he was educated in the schools of Nashua, N. H., and at Worcester Polytechnic Institute. He is a veteran of World War I, a former city councilman and school board president of Albany, Calif., former chairman of the Alameda County (Calif.) Democratic Central Committee and former director of the California State Fair and Agricultural Commission.

NEWS in VIEWS

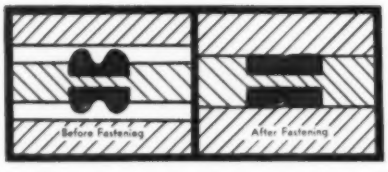


UP, UP, AND IN goes the lower half of Pontiac Eastern Corp.'s fluid coker reactor-fractionator. The 156-ft vessel is being erected in two sections, which will stand, when finished, 187 ft above grade. The unit is part of a $20-million, 11,000 b/d refinery being built by Fluor at Purvis, Miss., for October completion.

DO YOU KNOW ABOUT GASK-O-SEAL?



The static seal that can not blow out!



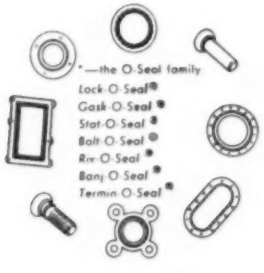
The above diagram is "typical" only. Gask-O-Seals are also made with one-side seals.

If you do not know about Gask-O-Seals look at these facts:

- Gask-O-Seals will seal practically any processable fluid . . .
- Gask-O-Seals can be re-used . . .
- Gask-O-Seals will seal at low or high pressures, vacuum or positive . . .
- Gask-O-Seals are available as standards and as specials in almost any configuration or to meet special requirements.

They are recommended for flanges, gear boxes, transfer cases . . . *any* place where truly efficient static seals are needed.

Note: A recent development of the Gask-O-Seal principle indicates effective sealing in the temperature ranges of −400° to +1000° for specific applications.



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Your Guide to . . . Petroleum Processing Departments

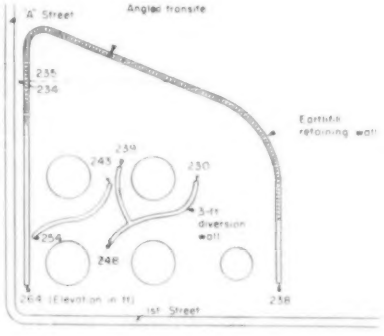
Keep Your Data File Up-to-Date

"Clip-n-File" process data
Olefin-Isobutane Alkylation

Another three-page, fold-out flow sheet, this one describing Phillips' popular alkylation process. Included are tables of typical operation and costs, and data on typical properties. See **p. 79**

"Clip-n-File" engineering data
Wire Rope—and Its Uses

What it is, how it's made, the types described, and construction materials. Also included is a table of safety factors. As usual, the EDS is printed on stiff paper for easier filing. See **p. 99**



Dig those crazy retaining walls

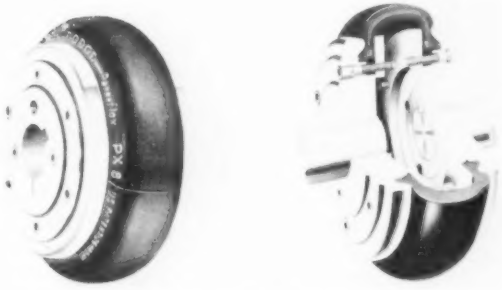
The explanation is simple: dikes take advantage of the tank area's rolling contour. The result: a low-cost, retaining-wall set-up. Read the details of this problem-solver in Plant Practices. **p. 83**

How to keep the wheels turning

Cats can be skinned in more than one way, and compressors can be set in less time than factory experts sometimes take to do the job. Read this month's Bull Pen to find out how the Old Man made the wheels turn a little faster. **p. 91**

Processing facts and figures

Do you check the Trends section regularly? Key industry statistics are tabled and graphed for quick reference each month. To get the current refining picture turn to the two fact-filled pages starting on **p. 121**



Coupling tames misalignment

It's not a tire, it's a versatile coupling that handles end-float and angular and parallel mis-alignment. The coupling, developed in Germany, is described with other new product developments in this month's What's New section **p. 129**

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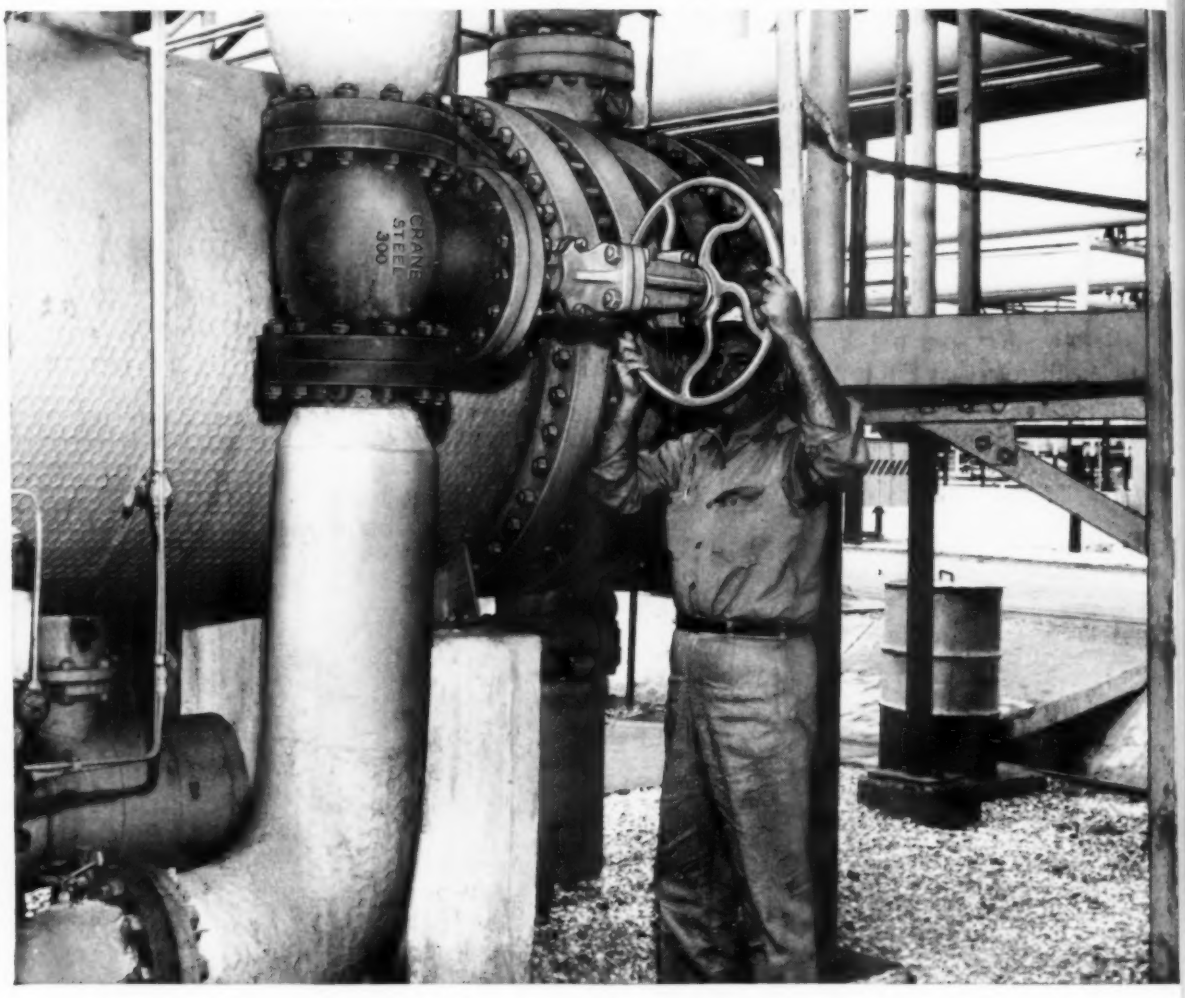
How Cit-Con stopped valve leakage in lube oil extractio



These Crane valves defy hot oil at 550° F.

You'll recognize smart planning in this valve installation at the Lake Charles, Louisiana, extraction tower of Cit-Con Oil Corporation, manufacturer of lubricants and waxes.

Before Cit-Con installed these Crane 8-inch No. 47X steel gate valves on lines to regulator, valves of another make were demanding frequent maintenance to cope with leakage of hot oil at 550° F.

The change to Crane completely corrected the problem. Why? Because Crane steel valves with Exelloy seating have those extra features that count in valve performance—better design throughout, finer workmanship and more thorough testing.

When you buy valves, you're wise to insist upon the engineering skill and quality manufacture you get when you order from Crane.

ASK TODAY for this book wit 32 industrial case histories. Co your Crane Man for a copy o "Valve Performance Facts."

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Area

Process—Olefin-isobutane alkylation using HF catalyst to make high octane gasoline stocks.

Process flow—Referring to the flow diagram, liquid feed containing olefins and isobutane is passed through bauxite driers and fed into the lower section of the reactor, while the liquid hydrofluoric acid enters the reactor through a recycle line connected to the bottom of the reactor.

The alkylation reaction is completed by intimate contacting, after which the hydrocarbon material and the recycle acid flow to the settler where a two-phase separation occurs. The acid phase is recycled back to the reactor. The hydrocarbon phase is fed to the fractionating section where the recycle isobutane is separated from motor-fuel alkylate.

As an auxiliary to the operation, an acid-rerun unit is provided where the hydrofluoric-acid catalyst is continuously purified by the fractionation of a small portion of the circulating acid stream.

Caustic washing is the only treatment employed on the motor-fuel alkylate, thus eliminating the former expense of catalytic defluorination.

Process variables—Reactor effluent is water-cooled to a temperature of 85-100°F, depending upon seasonal changes in cooling-water temperature. Variation within this 15°F temperature range does not have an appreciable effect on either product quality or operating cost.

The acid-hydrocarbon ratio of the reactor feed is not critical and ranges from 0.2/1 to 1/1.

For the purpose of product quality control, an excess of isobutane is recycled to the reactor with the olefin. External isobutane-to-olefin ratios from 2/1 to 20/1 have been used, but for motor fuel production the optimum will be about 7/1.

Process yields—Tables 1 and 2 show typical yield and product quality for Perco HF Alkylation of a catalytic-cracker C_4 fraction as feedstock.

Economics—Typical direct operating expenses for a Perco HF Alkylation unit are shown in Table 3.

Equipment—The present acid-hydrocarbon reactor is not equipped for mechanical agitation and is essentially a shell and tube heat exchanger. This simplifies the unit operation and reduces investment and operating costs.

Installations—Phillips presently operates two HF Alkylation units, one of which, considerably modified, is the first commercial HF unit ever installed. Present capacity of this unit is in excess of 10,000 b/d alkylate. In addition Phillips has licensed the process to six other companies. Four new units and one expansion program are under construction. All of the new units under construction are primarily for motor-fuel production.

Licensor—Perco Division, Phillips Petroleum Co., Bartlesville, Okla., is offering the license on the Perco HF Alkylation process. The license makes available know-how, engineering and operating techniques, as well as patent rights. Phillips can supply actual commercial operating data for practically any olefin feedstock that can be alkylated with isobutane.

REFERENCES

(1) "Commercial Alkylation with Hydrogen Fluoride," Frey, *Chem. & Met. Engrg.*, November, 1943.

(2) "Mechanical Operation of HF Alkylation Units," Findlay, *National Petroleum News*, May 2, 1945.

(3) "Corrosion in Hydrofluoric Acid Alkylation," Holmberg & Prange, *Ind. & Engrg. Chem.*, November 15, 1945.

(4) "Designing to Reduce Corrosion in HF Alkylation," Findlay & Prange, *Petroleum Refiner*, March, 1946.

(5) "Converting Non-Gasoline-Range Hydrocarbons into High Octane Blending Stocks," Bergen & Peters, *Control Engineering*, Sept., 1956.

(6) "New HF Alkylation Process," Peters & Rogers, *Petroleum Refiner*, September, 1955.

(7) *Hydrofluoric Acid Alkylation*, Phillips Petroleum Co., 1946.

Table 1—Typical HF Alkylation unit operation

(Basis: 100 B/D total feed)

Charge to unit, bbl	
Cat cracker C_4 fraction	
Propane	0.9
Propylene	0.9
Butylenes	32.5
Isobutane	40.2
n-Butane	25.5
Total unit feed, bbl	100.0
Yields from unit, bbl	
Propane	0.9
Isobutane	1.1
n-Butane	25.5
Alkylate	56.8
Total yield, bbl	84.4

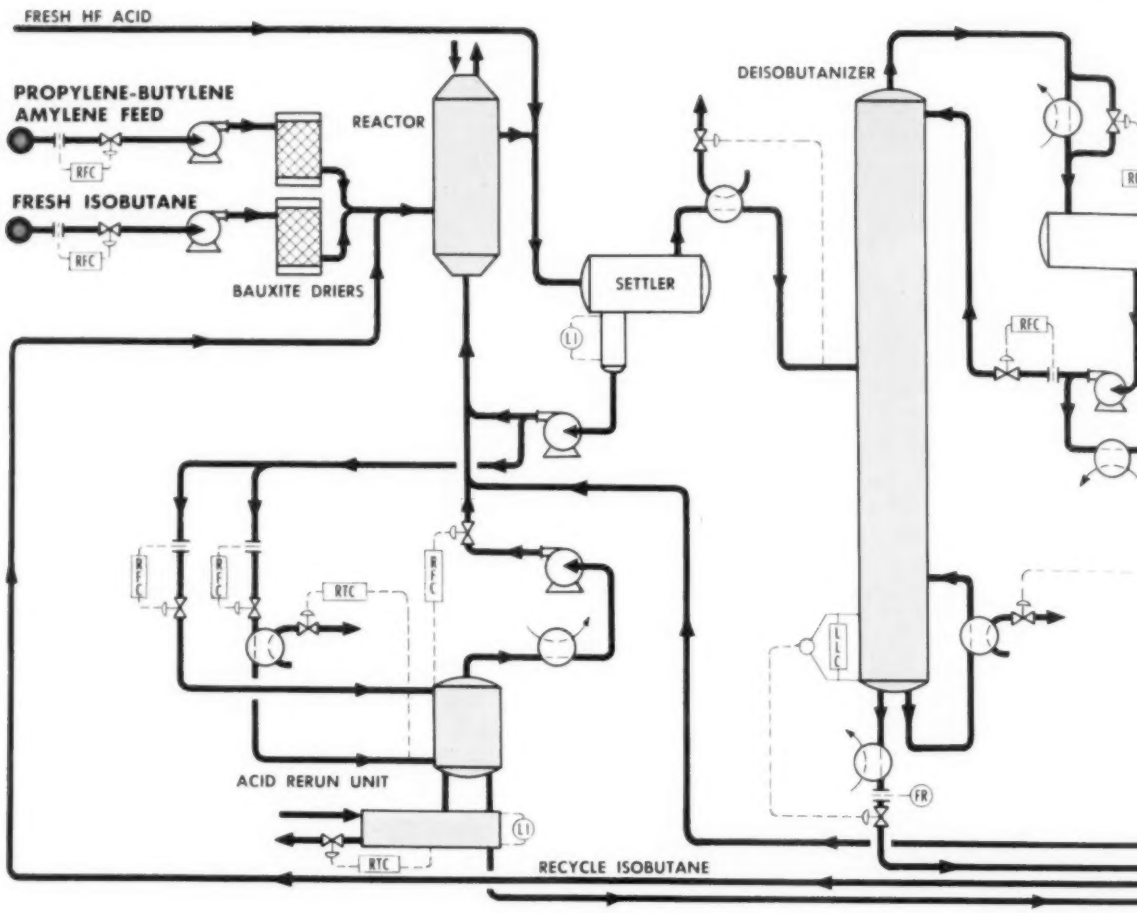


Table 2—Typical properties of debutanized motor-fuel alkylate

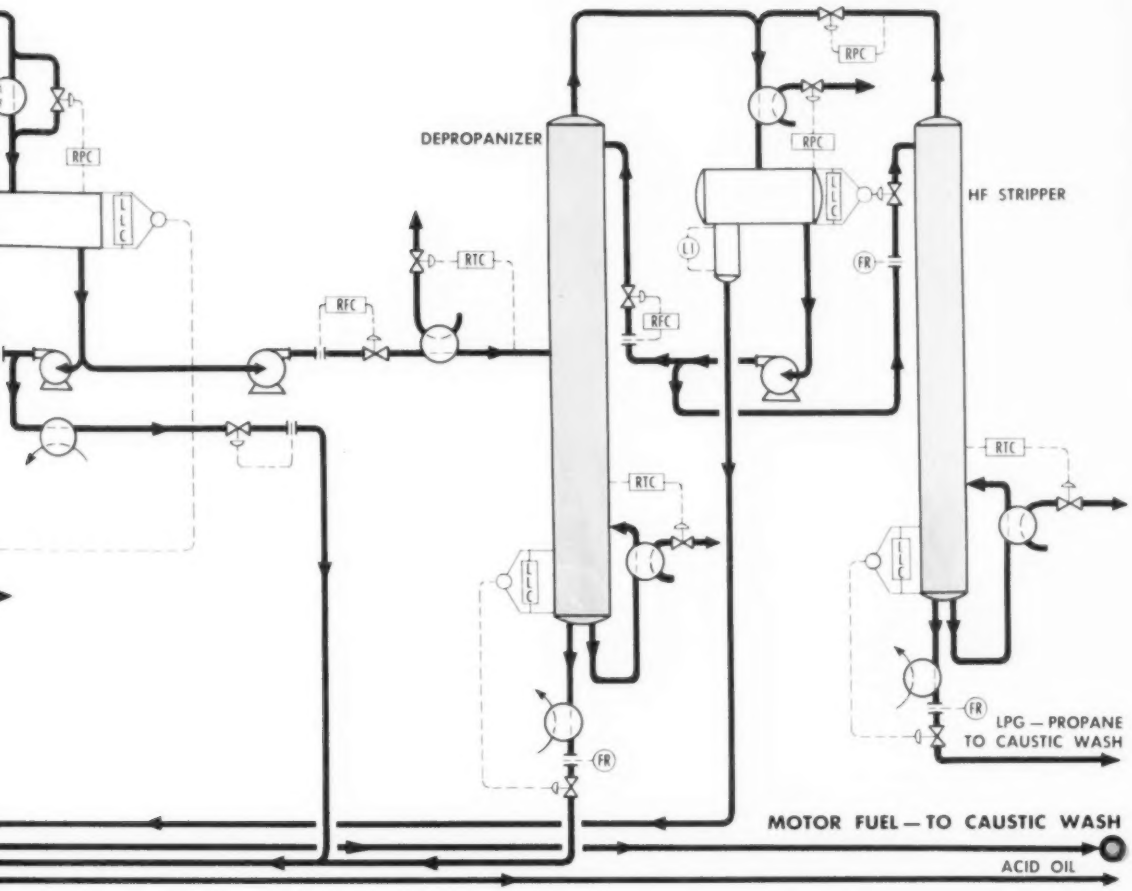
Gravity, °API	68.8
ASTM distillation, °F	
IBP	160
10%	199
20%	210
50%	224
90%	264
95%	336
EP	392
Color, Saybolt	30
Doctor Test	negative
Corrosion, 122°F	negative
ASTM Gum	0.4 mg/100 ml
ASTM Research Octane	
Clear	93.1
1 ml TEL	100.8(1)
3 ml TEL	104.9(2)

(1) Equivalent of ASTM Research Method rating of 0.036 ml TEL in isooctane. (2) Equivalent of ASTM Research Method rating of 0.34 ml TEL in isooctane.

Table 3—Summary of direct operating expense for Perco HF Alkylation

(98% stream factor)

	Amount/bbl alkylate	$/bbl alkylate
Operating labor		
(2 men/shift)	——	0.0800
Supervision and laboratory	——	0.0800
Repair labor and materials	——	0.1600
Utilities		
Steam at $0.30/M lb	7.5 lb	0.0023
Fuel at $0.15/MM Btu	1,050,000 Btu	0.1575
Circ. water at $0.015/M gal	1.728 gal	0.0259
Makeup water at $0.09/M gal	69 gal	0.0062
Electricity at $0.0057/kwh	1.989 kwh	0.0115
Chemicals		
Caustic at $0.035/lb	0.143 lb	0.0050
HF acid at $0.21 lb	0.270 lb	0.0513
Miscellaneous	——	0.0100
Total operating cost/bbl alkylate		0.5897



Olefin-Isobutane Alkylation

...using Phillips' HF catalyst process

UNFOLD FOR START OF PROCESS DESCRIPTION

Assures control of paraffin viscosity

EPOLENE "N"

Viscosity control of paraffin formulations calling for the addition of polyethylene is assured—if Epolene "N", Eastman polyethylene wax, is used. Because uniformity of coating paraffins is so important, Eastman takes special care to produce Epolene between narrow limits of viscosity.

Published specifications for the viscosity of Epolene "N" are within the range of 2200 and 2700 cps at 125° C—your assurance of close control and uniformity from batch to batch.

The table shows what this uniformity means in polyethylene-based paraffin formulations. Five percent samples of Epolene "N", from the *extremes* of our production range, were mixed with paraffin—and the viscosities of the resulting mixtures were taken on the same Brookfield Viscometer.

Sample	Viscosity at 200° F (cps)
100% paraffin	4.8
95% paraffin–5% Epolene "N" (2250 cps)	7.5
95% paraffin–5% Epolene "N" (2700 cps)	7.6

Although viscosity varies from paraffin to paraffin, these results dramatize the advantage of using Epolene "N". Thus, for the paraffin under test, the maximum variation encountered in the final viscosity of the 5% Epolene blend was only 0.1 centipoise.

To assist manufacturers in taking full advantages of the outstanding properties of Epolene "N", Eastman maintains an extensive technical service laboratory in Kingsport, Tennessee. Through this laboratory, paraffin formulators are offered expert assistance in formulations and manufacturing techniques.

For samples and further information, write Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Company, Chemicals Division, Kingsport, Tennessee.

Epolene

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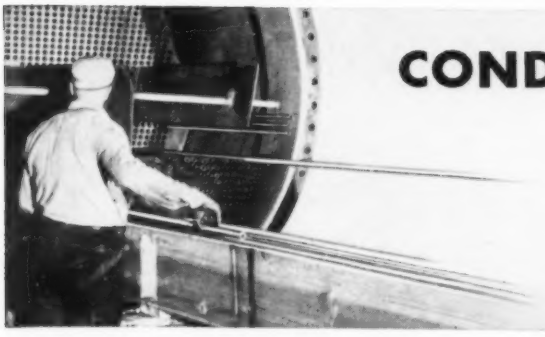
West Coast: Wilson Meyer Co., San Francisco Los Angeles; Portland; Salt Lake City; Seattle

(To obtain more data on advertised products see page 126)



CONDENSER TUBE CLINIC

Edited by **ARTHUR W. TRACY**, Metallurgical Engineer,
The American Brass Company, Waterbury, Conn.

Some operating factors that affect tube life

COMPOSITION OF THE COOLING WATER

The quantities of cooling water used in condensers preclude any treatment to make the water less corrosive, except where the water is recirculated. Economics often does not permit locating a power plant at a site where water is not corrosive.

In general, however, plants located inland will have relatively noncorrosive cooling water. Plants situated on tidewater will have corrosion problems, especially if the water is polluted with industrial or domestic sewage and conditions are such that organic matter in the sewage can ferment under anaerobic conditions, with the consequent formation of sulfides. Water in an enclosed harbor or dead-end channel, where the water is more or less stagnant, is particularly subject to infestation by anaerobic bacteria.

PREVENTIVE MAINTENANCE

Frequent cleaning of tubes to remove slimes containing bacteria and the simultaneous removal of sulfide scales will increase tube life. Chlorination of polluted water at frequent intervals, or periodically filling the water spaces in the condenser with chlorine gas, will not only remove the slimes but may also aid in breaking down the unwanted sulfide films which have formed on the inner walls of the tubes.

In some cases, it may be possible to dredge the channel bottom near the water intake to remove accumulations of decaying vegetable matter.

An American Brass Company Chemist uses Photo-Electric Colorimeter to analyze cooling water samples as a basis for tube alloy selection.

MEDIA BEING COOLED OR CONDENSED

It is not usually possible to change the corrosive properties of products being handled in the process industries. The venting of noncondensable gases, however, will markedly increase tube life. This is particularly true on the steam side of boiler feed-water heaters and other steam-heated equipment where accumulations of oxygen, carbon dioxide, and ammonia can cause rapid failure of condenser tubes.

TEMPERATURE

The corrosion rate of metals usually increases with increasing temperature. This is a problem particularly in refinery condensers where water velocities are often relatively low and the water temperature is relatively high. At low water velocities, the formation of gas bubbles on the water side of a tube can initiate pitting which may continue even after the bubble has disappeared. In such cases, a judicious increase in water velocity will insure longer tube life, provided the velocity is not increased to a point where impingement corrosion can occur.

Many believe that condenser tubes put in service in the winter when water is cool will last longer than those started in the summer. A more protective film of corrosion products forms on the tube wall in winter, probably because the water is freer of sulfides.

TECHNICAL HELP IN SELECTING TUBES

Your situation may require special consideration and analysis. We are always ready to help and advise in the selection of the right alloy to give best service. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

ANACONDA®

Tubes and Plates for
Condensers and Heat Exchangers
Made by
The American Brass Company

PHYSICAL PROPERTIES OF ANACONDA CONDENSER TUBES*

ALLOY	Tensile Strength, psi	Yield Strength at .5% Elongation Under Load, psi	Elongation in 2", %	Rockwell Hardness, B Scale	Density, Lb. per Cu. In.	Thermal Conductivity, B.T.U./Sq. Ft./In./Hr./°F. at 68° F.	Average Coefficient of Linear Thermal Expansion per °F. (77-572 F.)
Arsenical Admiralty-439	52,000	22,000	60	6-45	0.308	768	.0000112
Ambraloy-927	60,000	27,000	55	35-65	0.301	696	.0000108
Ambraloy-901	60,000	30,000	60	30-60	0.295	552	.0000099
Cupro Nickel, 30%-702	55,000	22,000	50	30-60	0.323	204	.0000090
Cupro-Nickel, 10%-755							
Light Annealed	44,000	22,000	46	25	0.323	314	.0000093
Light Drawn	60,000	57,000	15	68			
Red Brass-24	42,000	15,000	50	0-30	0.316	1104	.0000104
Ambronze-421	46,000	20,000	55	0-30	0.316	830	.0000102
Phosphorized Arsenical Copper-108							
Light Drawn	40,000	35,000	20	20-50	0.323	1344	.0000098
Hard Drawn	54,000	50,000	8	50-70			
Phosphorized Copper-103							
Light Drawn	40,000	35,000	20	20-50	0.323	2364	.0000098
Hard Drawn	54,000	50,000	8	50-70			

*Note: The above values are approximate and should not be used for specification purposes. *Light annealed except as noted.*

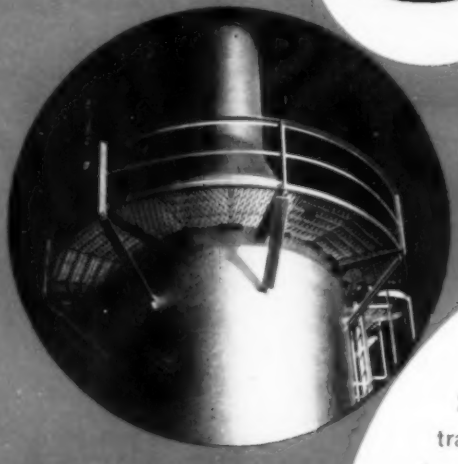
 (To obtain more data on advertised products see page 126)

you can judge

the comparative values of furnace design as applied to operating requirements.

It's quite simple

there are 9 basic factors which must be evaluated to obtain the full comparison of values



1—Average radiant transfer rate. 2—Maximum deviation from average radiant transfer rate. 3—Average and maximum transfer rate in convection section. 4—Maximum tube wall temperature, radiant or convection. 5—Maximum efficiency with specified excess air. 6—Controlled thermal recirculation of flue gases to provide even heat distribution throughout full length of each tube and equalized heat distribution around each tube. 7—Overload and corresponding transfer load. 8—Design to provide: structural column supports - Ladders - Platforms - Tube Removal facilities, etc. 9—Degree of assembly; of the furnace structure and of the heating surface.

Whenever all these 9 specifications are applied to all the operating requirements, you can be sure PETROCHEM ISOFLOW FURNACES will be found most economically desirable.
No other furnace design can claim the recognition and acceptance achieved by PETROCHEM ISOFLOW FURNACES . . . starting with one installation in 1940, January '57 records more than 1650 ISOFLOW FURNACES in operation and under construction—a record that is incomparable just as all Petrochem Isoflow furnaces are more economically desirable by any comparison.

PETROCHEM-ISOFLOW FURNACES

UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

PETRO-CHEM DEVELOPMENT CO., INC. • 122 EAST 42nd St., New York 17, N. Y.

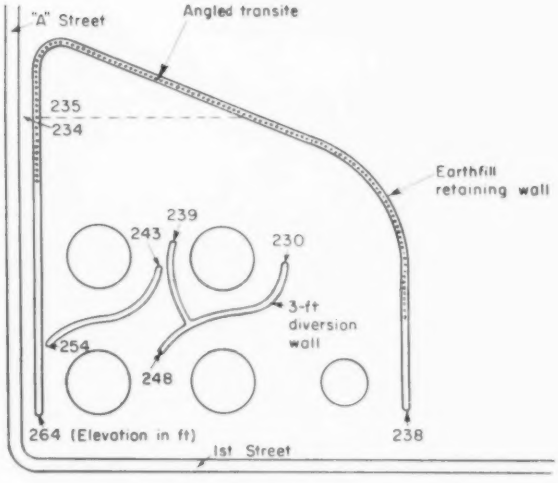
REPRESENTATIVES:

Rawson & Co., *Houston* • Wm. H. Mason Co., *Tulsa* • Lester Oberholtz, *Los Angeles* • Faville-Levally, *Chicago* • D. D. Foster, *Pittsburgh* • Turbex, *Philadelphia* • Flagg, Brackett & Durgin, *Boston* • G. M. Wallace & Co., *Denver & Salt Lake City*

International Licensees and Representatives: SETEA-S.A. Comercial, Industrial, y de Estudios Tecnicos, *Buenos Aires, Argentina* • Industrial Proveedora, *Caracas, Venezuela* • Societe Anonyme Bourtay, *Paris, France* • Societe Anonyme Belge, *Liege, Belgium* • Bourtay Italiana S.P.A., *Milan, Italy* • Birwelco Ltd., *Birmingham, England*

PLANT PRACTICES

By WILLIS A. BUSSARD, Associate Editor



Slope eliminates separate retaining walls

RATHER than fight the sloping terrain at its Ferndale, Wash., refinery, General Petroleum took advantage of it. As a result, one retaining wall in a group of oil storage tanks now does the work of several. And the overflow from any one of the tanks is still kept separate from the other tanks in the group.

By using the sloping topography, General Petroleum is able to let escaping oil from a ruptured tank drain away from the tank, rather than confine itself in a small area around the tank. Vic Stanich, chief engineer at the refinery, believes this drainage will be an advantage in event of fire. The design is also more economical because it requires lower and fewer retaining walls.

Where one tank lies within the normal drainage area of another, a diversion wall 3-ft high is constructed to direct the flow around the tank. This wall, as well as the outer retaining wall, is made of compacted earthfill. The outer retaining wall is topped with transite flashing, angled in from the top of the earthfill to prevent oil from flowing over it in the event of a sudden tank rupture.

The walled-in area has a drain at its lowest point, which is connected to an impounding area some distance away. From there the oil escaping from any of the tanks may be reclaimed.

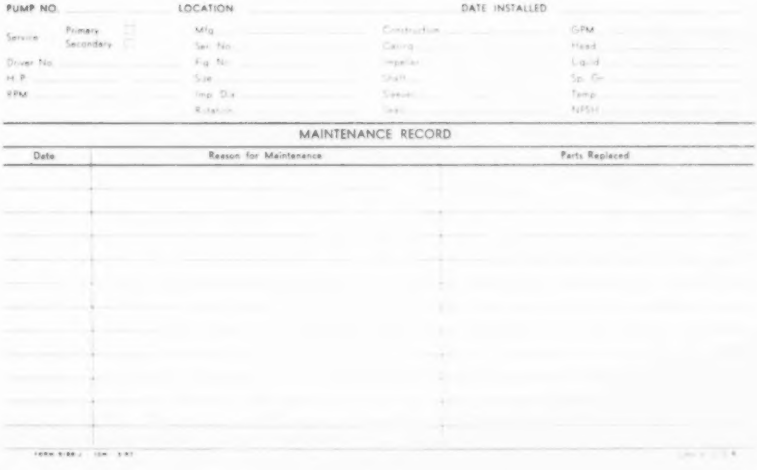
This same type of retaining-wall system pictured in the above set of five 134,000-bbl crude oil tanks is used in all storage tanks at this Washington refinery.

Keeping a card file on your pumps?

IF NOT, you should consider some of the benefits other maintenance men in refineries and petrochemical plants are getting from adequate but simple records. File cards for keeping tabs on plant pumps can be as simple as the sample shown.

Records with complete information on both operating and spare pumps, which are filed in an accessible location, can be extremely valuable in ordering repair parts, establishing optimum lubrication and maintenance schedules, and in diagnosing pump failures.

Complete information on the cards should include manufacturer's name, figure number, size, serial number, type and materials of construction, rated capacity and head, driver horse-


PUMP NO. LOCATION DATE INSTALLED

Service Primary Secondary

Mfg. Construction GPM

Ser. No. Casing Head

Fig. No. Impeller Liquid

Size Shaft Sp. Gr.

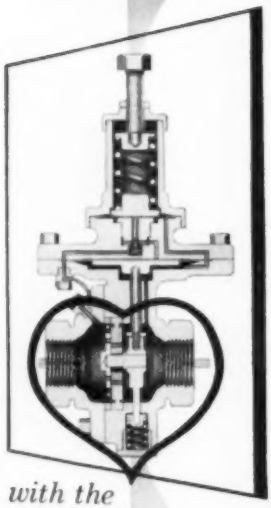
Imp. Dia. Sleeves Temp.

Rotation Seal NPSH

MAINTENANCE RECORD

Date	Reason for Maintenance	Parts Replaced

OPW-JORDAN
pilot-operated
pressure
reducing
VALVE



with the sliding gate & plate

The Heart of the OPW-JORDAN Valve

UTMOST SENSITIVITY AND ACCURACY OF REGULATION

Compensates for changes in inlet pressures and downstream demands

- DEAD END SHUT-OFF
- WIRE DRAWING MINIMIZED OR ELIMINATED
- SELF-LAPPING SEAT
- ELIMINATES VALVE CHATTER

Simplicity of sliding gate design eliminates causes of "down-time" commonly associated with pilot-operated valves. The No. 1160 offers a different and improved way to accurate control with all of the desired sensitivity of response.

For more facts, write for Bulletin J-1160.

JORDAN CORPORATION
Division of OPW Corporation

6013 WIEHE ROAD
CINCINNATI 13, OHIO
ELMHURST 1-1352

power, rpm and lubrication requirements.

The record should also have sufficient space for brief notations of failures and troubles, date and time they occurred, and the repairs and parts required to return it to service. With this information on file in an accessible location, special trips to examine the pump in the field are unnecessary. Repair parts can be ordered quickly without delay, and suitability of an existing pump for new process conditions can be determined.

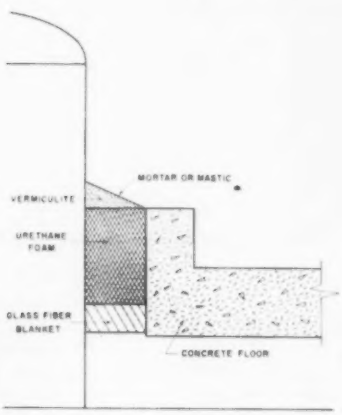
Color tabs on the file cards can be used to identify critical pumps that will stop production if they fail. Maintenance schedules on these primary pumps can be established to prevent the need for shutdown while the unit is operating.

Lubrication schedules on all pumps can be set up and recorded on the cards. Because most modern pumps have grease-lubricated ball bearings that require lubrication every 2,000 hours, additional grease is added about every three or four months. A pump check sheet made up from the information on the pump file cards will help omit lubrication from inaccessible pumps, such as sump pumps and others which can cause trouble if not lubricated at the proper intervals.

Pump failure and repair notations can be used to define the optimum period for complete inspection and overhaul of any pump in the refinery. Frequent notations of this sort on any one card will indicate that more frequent overhauls should be made—or that something is wrong in application, installation or operation of the pump. Chronological listing of failures will help diagnose this kind of trouble.

Spare parts inventory can also be maintained from these pump card records if they are kept up to date. Also, frequent replacement of the same part may be a red warning light that the wrong type of material is being used in some troublesome part.

Pump records of different types are kept by many maintenance departments, and one pump manufacturer (Goulds Pumps) will supply cards similar to the one illustrated for those requesting them. But no matter in what form the records are kept, frequent reference to them will eliminate a few of the troubles normally met in maintaining refinery or petrochemical-plant pumps.



Floor openings sealed with foam

AT Du Pont's petrochemical and chemical plant at Deepwater, N. J., new products are often tested under severe operating conditions. Some fail quickly while others, like the urethane floor seal above, come through with flying colors.

Du Pont first experimented with urethane foam as insulation for valves, fittings and vessels with irregular shapes. By foaming in place, low-cost insulation with desirable properties of light weight, low thermal conductivity and resistance to flexural stress damage was developed.

Four years ago, as an experiment, the annular floor openings around multi-story equipment were filled with

(To obtain more data on advertised products see page 126)

124,500 B.S.D. of NEW CAPACITY

IN FOUR NEW PROCESSING UNITS BY McKEE AT WOOD RIVER, ILLINOIS

STREAM This new Platforming Unit recently went on stream with a 20,000 B.S.D. capacity. It was designed, ructed and completely equipped by McKee.

UNDER CONSTRUCTION This Catalytic Reformer designed and being constructed by McKee will add 7,500 B.S.D. to processing capacity in the Wood River area.

ENGINEERING A 67,000 B.S.D. Atmospheric-Vacuum Crude Disilltation Unit now on McKee ng boards will be constructed by McKee at Wood River.

IN ENGINEERING A 30,000 B.S.D. Fluid Catalytic Cracking-Vapor Recovery Unit scheduled for Wood River is to be designed and constructed by McKee.

McKee
ENGINEERING &
CONSTRUCTION
Services

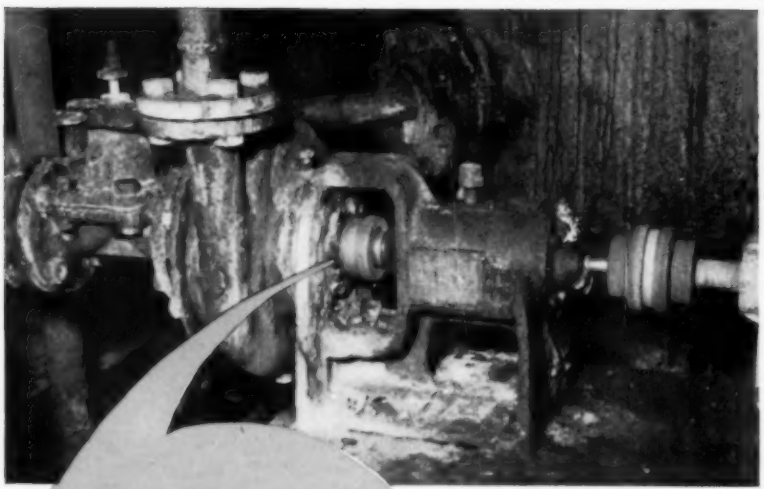
EACH of these Wood River projects represents a repeat contract that was awarded to McKee by a satisfied customer who has had previous proof that *McKee builds plants that earn profits.*

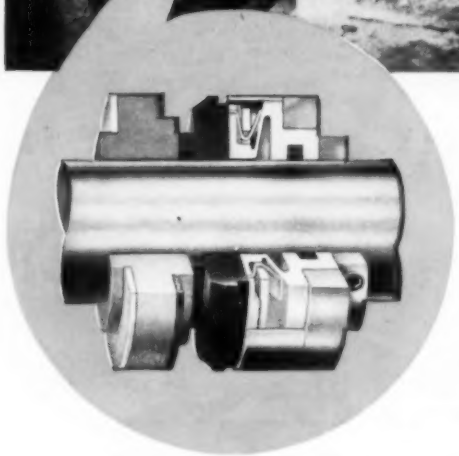
Arthur G. McKee & Company • Engineers and Contractors

Headquarters: McKee Building • 2300 Chester Avenue • Cleveland 1, Ohio
Offices: New York, N.Y. • Union, New Jersey • Washington, D.C.
British Representatives of Metals Division: Head, Wrightson & Co., Limited
Canada: Arthur G. McKee & Company of Canada, Ltd., 372 Bay St., Toronto

sealing against 95% H_2SO_4
at 70°C. to 90°C. for 15,000 hours
continuous service at 1750 R.P.M.

..a Chemiseal's record at Kolker Chemical Co.





This Chemiseal All-Teflon Mechanical Seal —first of four installed at this plant and all serving with equal satisfaction—was the third type of mechanical seal to be tried for the application, after other makes had quickly failed.

The user's comment is, "No praise is too high for this seal."

What are your shaft sealing problems? Why don't you investigate Chemiseal—the mechanical seal of Chemically Impervious, Pressure-Balanced Teflon Bellows Design. It will pay you in longer, trouble-free life.

Write for Bulletin MS-1155.

United States Gasket

United States Gasket Company
Camden 1, New Jersey

Plastics Division
OF THE GARLOCK PACKING COMPANY

urethane foam, replacing the previous sheet-lead flashing. One of the biggest advantages during installation was the chance to install the material without interrupting production in "no flame" areas.

The floor-seal construction adopted at the Chambers Works at Deepwater is pictured on p. 84. A Fiberglas blanket slightly oversize is pushed into the space between the vessel and the floor. It serves as the bottom of the casting form. The foam-producing ingredients are mixed according to directions and poured into the form. Within a few minutes the liquid expands to 20 to 30 times its original volume, fills the void and adheres tightly to the adjoining surfaces. In about half an hour the foam is ready for a topping of vermiculite concrete.

Recent inspection of these trial installations after four years of corrosive chemical conditions showed the urethane insulation to be in excellent condition. The plant now believes that these closures will have a service life of fifteen years, and save $100 to $200 per installation.

Based on the success of this experiment, nine newly installed five-foot-diameter kettles were sealed in place after regular production was already underway, with agitators running, steam on the jackets, etc. And now this method of sealing floor openings is standard at the Chambers Works.

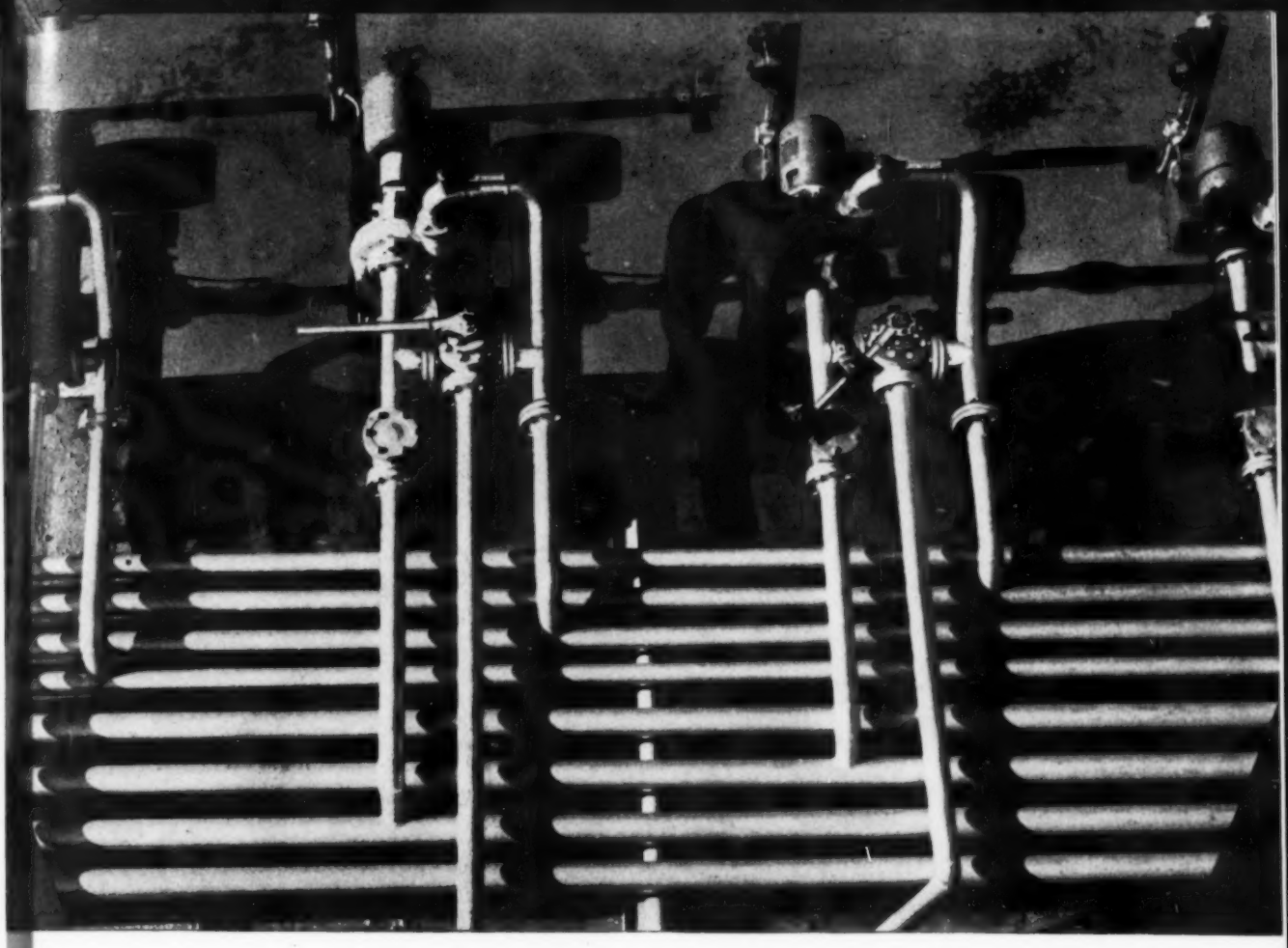
How one shop takes care of stream analyzers

AT the Texas City plant of Monsanto Chemical Co., the instrument department has developed a protective maintenance program for analyzers that has two purposes: to prevent trouble, and to locate and correct trouble in the shortest time. By actual experience in keeping a great many analyzers operating successfully, the program has proved adequate.

To prevent trouble, checking on a routine basis is the first requirement. Frequency of the checks depends on two factors: the nature of the process stream being analyzed, and the importance of the instrument's performance to successful operations. A clean, noncorrosive stream may require checks on a weekly basis involving only two to four manhours per week, while a dirty corrosive stream may require daily checks involving as much as twenty to twenty-four manhours per week.

To locate and correct the trouble in a minimum of time, the analyzer system is broken into three parts for

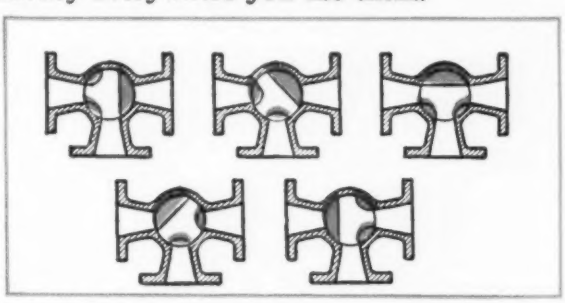
(To obtain more data on advertised products see page 126)



HERE'S AN UNUSUAL LOOK AT COST CUTTING

Each Rockwell-Nordstrom Multiport valve in the photo above is doing the job of *three* ordinary valves. This means that 12 ordinary valves are replaced by just 4 Multiports at a substantial saving in the cost of valves, flanges, piping and fittings. And their simple, easy operation—just a quarter-turn—assures further savings in terms of foolproof flow control. Wasteful production errors are eliminated. Multiport valves cost less to use, too . . . the pressurized lubricant that forms a positive, leakproof seal also acts as preventive maintenance against high repair costs.

Rockwell-Nordstrom Multiport and Straightway valves are the world's most complete and versatile line of lubricated plug valves. They cost no more to buy, often less than ordinary valves and they'll save you money everywhere you use them.



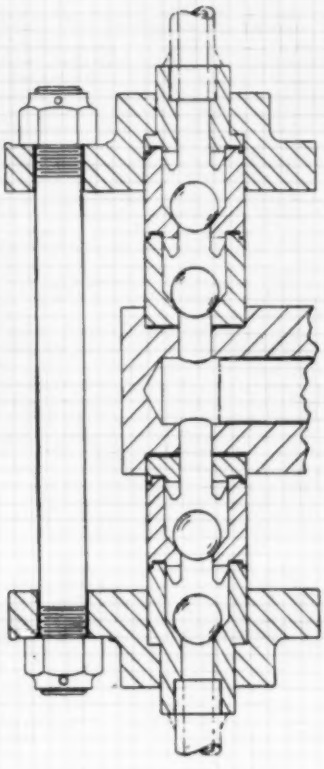
Here are just a few of literally hundreds of port and stop arrangements possible with Multiport valves.

For more information see your supplier or write Rockwell Manufacturing Company, Pittsburgh 8, Pa. *Canadian Valve Licensee:* Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES

LUBRICANT SEALED FOR POSITIVE SHUT-OFF

advanced design in high pressure pumps



SPECIAL HIGH PRESSURE LIQUID ENDS

VALVES are of the ball-guiding cone seat type. (Under high pressure conditions, balls do not seat properly on conventional ring seats, without guides.) Pressure drop is in direct ratio to ball rise. Valves are machined from solid stainless steel bar. Balls are hardened and ground stainless steel. They may be spring-loaded for down-stream pumping and viscous materials (up to 30,000 SSU).

HEADS are forgings or castings, depending upon size.

PISTONS are highly polished stainless steel or ceramic, ground and polished, as required.

PACKING is contained in the gland, *not divided*. Gland take-up is a screwed nut rather than a lantern flange, insuring even pressure on packing—*no cocking*.

Write for Bulletin HP-1254.

PHILADELPHIA PUMP DIVISION OF AMERICAN METER CO.

13500 Philmont Avenue, Philadelphia 16, Pa.

PHILADELPHIA SERIES HP HIGH PRESSURE PUMPS

trouble shooting. These are: sample system, recorder and electrical transmission, and the analyzer proper. The most important part for proper analyzer operation has proved to be the sample system.

Records show that inadequate and poorly designed sample systems will double and triple the amount of maintenance necessary for good operation of a stream analyzer. At the same time, the same poorly designed sample systems will seriously detract from the quality of the analyzer's results.

The sample system, whatever its design, is inspected daily, with close attention given to flow, pressure, and pressure drop across the system. The sample system is cleaned on a routine basis, frequency depending on actual practice. Maintenance records show that about two manhours per week are required to maintain the average sample system and keep it functioning properly. A weekly calibration check takes 1½ manhours.

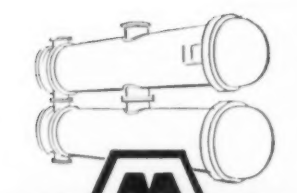
However, when trouble occurs, systematic trouble-shooting techniques must be followed in order to locate and correct the difficulty in the shortest possible time. Monsanto's records show that the sample system of the analyzer causes 90 to 95% of the trouble in these installations.

If the sample system is functioning properly and delivering the required sample to the analyzer, the next section to check for trouble is the recorder. A reliable check is to disconnect the analyzer from the recorder and substitute a dummy analyzer of precision resistors of the proper value, and observe recorder response. If the trouble is in this section, it will be evidenced by erratic or noisy behavior. Practical electrical transmission and electronic amplifier trouble-shooting techniques can be used to correct this kind of trouble.

If the sample and recorder sections are trouble-free, the analyzer section must be checked. A reliable test is to run the analyzer with a synthetic sample of known composition, having an analysis approximately mid-range of the analyzer. This kind of test generally requires from two to twenty-four hours, which is usually sufficient time to obtain performance data indicating source of trouble. Once the trouble is located, techniques adaptable to the type and make of the analyzer can be used.

NEED CASH? We need Plant Practices Items. Why not send in your favorite ideas? Don't worry about finished style, we'll add the polish—*Plant Practices Editor*

Any Size...Any Design



Size or complexity makes no difference to the prompt and efficient service that The M. W. Kellogg Company offers to the process industries on heat exchangers. Whether it's an order for a single 14-ft. diameter giant, like the one above, or a group of normal size units, Kellogg's recently expanded facilities are geared to produce to the strictest design standards and delivery schedules. With these facilities, Kellogg can handle the complete job of designing, engineering, and fabricating heat exchangers, or make exchangers to customers' own designs.

FABRICATED PRODUCTS DIVISION

THE M. W. KELLOGG COMPANY

711 THIRD AVENUE, NEW YORK 17, N. Y.

A SUBSIDIARY OF PULLMAN INCORPORATED

The Canadian Kellogg Company Limited, Toronto • Kellogg International Corp., London • Kellogg Pan American Corp., New York
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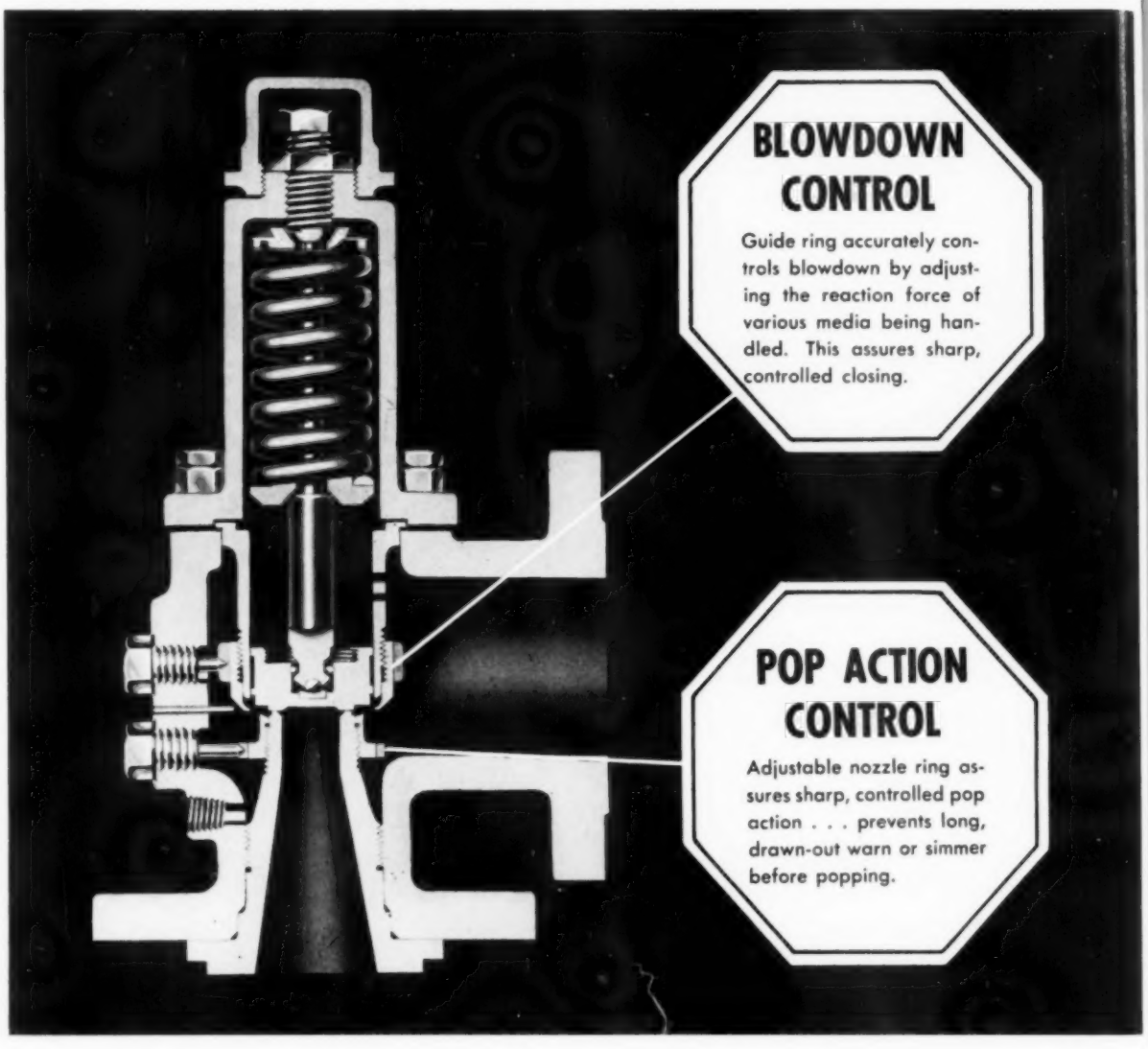

BLOWDOWN CONTROL
Guide ring accurately controls blowdown by adjusting the reaction force of various media being handled. This assures sharp, controlled closing.
POP ACTION CONTROL
Adjustable nozzle ring assures sharp, controlled pop action . . . prevents long, drawn-out warn or simmer before popping.

Look for these Signs of Safety

PERFORMANCE is built into every Crosby Nozzle Type Safety-Relief Valve—in basic engineering, in quality materials, and in precision workmanship. Crosby Valves meet the needs of Industry for maximum operating dependability and minimum downtime and maintenance. Because they incorporate generous safety factors, these valves stay on the job for years.

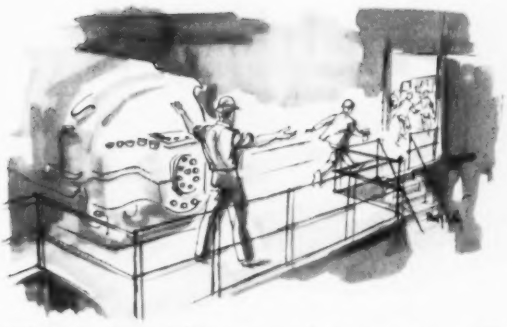
Write for Bulletin describing the complete line of Crosby Relief Valves—or ask for our quote on your valve requirements.

CROSBY VALVE & GAGE CO.
43 KENDRICK STREET, WRENTHAM, MASS.

Crosby
KEEPS PRESSURE ON THE SAFE SIDE

(To obtain more data on advertised products see page 126)

How to Keep the "Wheels" Turning



"Wait a minute fellas, you can't leave us here with that compressor half set!"

"BLESSED are they who go around in circles, for they shall be called 'wheels,'" the Old Man was saying. He was in one of those moods when his breath would etch glass.

The wheels he referred to were the three erectors supervising the installation of our first big, high-speed centrifugal compressor. One of these boys was out of our home office, an "expert" on centrifugals, who was sent down to approve our erection of the machine. Nothing could go until he was satisfied.

The other two were factory men from the turbine manufacturer and the compressor manufacturer. They had to be satisfied too.

The big trouble was that these guys could never get together on what was good enough—the job was going to be held up if they didn't make up their minds, and soon.

Truth is, they were afraid of the machine. The compressor man worried about the rotor balance—we took it out and checked it. We replaced one thrust bearing; the seal oil wouldn't get clean enough, even though we had been circulating about three weeks. The turbine man was just as exacting—we were close to wearing the machine out trying to get it set just so. To our home-office man, nothing was right.

Anyway, the Old Man was fed up with all this half-baked pussyfooting. He had a plan—I was to do the dirty work. "That machine's as right as it'll ever get," he said. "We're gonna have to scare 'em out."

That afternoon, I drifted over on the job. "How's it goin'?" I asked.

The turbine was nervous. "You guys got too much strain on the steam piping—it's pullin' my turbine out of alignment."

"I thought we fixed that last week."

"Yeah, it was all right then but sompin's happened—sompin's pullin' my turbine out. Maybe the foundation's settlin'." The more this guy worried, the wilder he got.

The other two erectors had their shoulders full of troubles too, so I changed the subject. "What you fellas need is a good cuppa coffee and a cigarette—come on over to the Bull Pen and I'll buy."

The Old Man was talking to Solly and Dutch when we walked in, so we quietly drew our coffee and went to a table over in the corner. The Old Man was talking loud enough for us to hear. "We got to be careful this time—don't let anybody on that unit who doesn't have to be there."

"What's he talkin' about?" the compressor man wanted to know.

"About that old unit we're re-working—wild, you know."

"No, I didn't know. What happened?"

"Nobody knows. All of a sudden—poof! Come on, I'll give you a ride back to the job." I put on my best worried look.

When we got back on the job, the fire department was dragging in so much fire-fighting gear we could barely walk through to the compressor building.

"What's goin' on?" the home-office man asked.

"Can't take any chances when you start these things up. No tellin' what'll happen."

"When you figurin' on startin' up—we're not through with that compressor yet."

"Oh, we're gonna fire up the high-pressure side of the unit tonight and try to get it lined out. The compressor is on the low-pressure side." I didn't know any more about that unit than these fellas did, but they took it all in.

Next morning, when the three of them came on the job, they had to pass right by the ambulance parked at the battery limit. "Just in case," I said. An old air receiver that had split years ago had been hauled over from the scrap yard and was lying out in the middle of the unit. "Same old story," I sighed as we passed it. Solly was running one heater with a bad burner orifice, and the thing was screaming like the demons of hell.

"I don't feel so good," the turbine man said.

"I got to go phone my office," said the compressor man.

The home-office man had to call his wife. "She wasn't feelin' so good last night."

"Wait a minute, fellas," I yelled, "You can't leave us here with that compressor half set. We gotta have that machine when we get ready for the low-pressure side." I finally persuaded them to stay.

We doubled up the machinist gang on the machine that day, added pipefitters and got about setting that thing in earnest. About every hour, Solly had his operator start up the instrument air compressor just outside the building and pop the safety on the drum. By the end of the day, I was as shook up as those three erectors, but the compressor was ready to go—and believe me, so were those fellas!

Next month, the long expected happens. Cruse blows his fuse

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The Tretolite Company furnishes a list of the equipment required, instructions for installation and, working drawings, designed to tie in with the flow stream in the customer's refinery. Data on the rate of Tretolite injection for optimum desalting results, operating instructions, temperatures, pressures and water requirements are also included. Tretolite Refinery Service Engineers check construction procedure to insure that installation is according to specifications; they also assist with start-up and make periodic visits after the unit is in regular operation.

2 Outright Purchase

The Tretolite Company ships the desalting plant equipment to the refinery. Erection is then carried on by refinery personnel or by an erector of the customer's choice. Inspections during construction, start-up assistance, and periodic inspections are provided by the Tretolite Refinery Service staff as in plan No. 1. When the desalting plant is ready to go on stream, Tretolite Refinery Service Engineers supervise an acceptance test run to meet the guarantee of minimum chemical requirements and salt removal efficiency as set forth in the contract.

3 Rental with Option to Purchase

The rental plan is similar in all general respects as to instructions, supervision and materials furnished in plans No. 1 and No. 2. After acceptance requirements have been fulfilled, the pre-determined annual rental fee is payable according to the payment option selected by the customer.

After the plant has been operated for three years on the rental basis, the customer has the option of purchasing the equipment for a pre-determined price. (This price is reduced after each year's rental.) After a unit has been used on a rental basis for seven years, the annual rental fee is reduced about 50%.

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Do You Know These Words?

By B. H. WEIL

A regular department intended to help both administrators and operating men keep abreast of technical names and processes in the petrochemical field.

Isopropanol

Isopropanol, also known industrially as "isopropyl alcohol," was the first U. S. commercial petrochemical and is still a most important one. Pronounced **"eye**-so-**pro**-pah-noll," and having the formula $CH_3 \cdot CHOH \cdot CH_3$ (propane in which one of the hydrogen radicals on the center carbon atom is replaced by an alcohol radical, -OH), this petrochemical is a colorless, clear, flammable liquid, lighter in unit weight than water and boiling at 180°F. Because it freezes at —126°F, and is soluble in water, it is not surprising that isopropanol at times finds extensive use as an antifreeze.

Isopropanol has many uses. As the raw material for most of the production of acetone, it is thus a key intermediate in the production of acetic anhydride, methyl isobutyl ketone, etc. It is a widely used industrial solvent, and is employed in many pharmaceuticals and cosmetics. Other uses are as preservative, gasoline antistalling agent, dehydrating agent, etc.

The petrochemical synthesis of isopropanol involves the reaction of propylene with sulfuric acid, followed by hydrolysis (reaction with water). Propylene, of course, is recovered from refinery cracked gases, or is prepared by the dehydrogenation of propane (itself an LPG or LRG).

Isopropanol competes with several other petrochemicals, both as a chemical intermediate and solvent. Its low cost and versatility, however, will probably keep it in the forefront of the petrochemical field.

Carbon Monoxide

Carbon monoxide is commonly feared as a deadly gas in coal mines or when automobiles are left running in closed garages, but it is also a most important petrochemical intermediate. A colorless gas with a faint metallic odor and taste, it is slightly lighter than air. It has the formula CO—one atom of carbon and one of oxygen—which explains its flammability, because it can add another atom of oxygen, on burning, to become carbon dioxide, CO_2.

Carbon monoxide is used in organic synthesis (of alcohols such as methanol and acids such as acetic), in metallurgy (special steels, reducing oxides, nickel refining), as a reactant in the Fischer-Tropsch synthesis of gasoline ("hydrogenation of carbon monoxide"), in the synthesis of metal corbonyls, etc. It is also a constituent of fuel gases such as water gas.

As a petrochemical, carbon monoxide is usually obtained as a coproduct or by-product with hydrogen, by the partial combustion of natural gas or heavier hydrocarbons, or by the catalytic reaction of these petroleum materials with steam (the so-called "methane-steam reaction"). For certain uses, it is obtained by the reaction of carbon dioxide and oxygen over an incandescent bed of coke or anthracite. As mentioned, moreover, it is a constituent of water gas (produced by the action of steam on coke or coal) and can be obtained from this.

Certain chemicals, themselves valueless or even dangerous, are building blocks in the synthesis of other and valuable materials. Carbon monoxide is certainly in this category.

Mr. Weil is chief editor of Esso Research and Engineering Co.'s Technical Information Division. He was until recently with Ethyl Corp.'s Research & Engineering Department.

NEWS in VIEWS

OVER 45 TONS-WORTH of unusual secondary fractionating tower is going up at Sinclair's Corpus Christi refinery. Access to the 24 trays and demister is through 28 manways. I.D. ranges from three to six ft.

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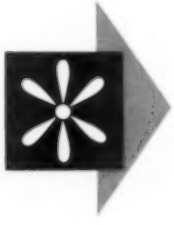

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All data of confidential nature are of course treated accordingly.

Moore Succeeds Smith at Amoco

AFTER 41 years with the company and its affiliates, Donald J. Smith has stepped down from the presidency of American Oil Co. and turned the post over to L. W. Moore. Moore was elevated from executive vice-president, a post he has held since Pan American Refining Corp.'s functions were assumed by Amoco.

Mr. Smith

Mr. Moore

Smith began in the petroleum industry with Indiana Standard in 1916, two years after his graduation from the University of Illinois. Later, he spent several years in Casper, Wyo., as chief engineer of the Rocky Mountain division. In 1927 he was made assistant to the general manager of manufacturing of Pan American Petroleum & Transport Co. He became manager of manufacturing in 1932, and a year later was made manufacturing vice-president for Pan American Refining Corp. He took the president's job in 1944, and three years later became president also of Pan American Transport, the parent firm. In 1954, after both firms went out of existence, Smith was named president of American Oil.

Moore began with Amoco's parent firm, Indiana Standard, in 1933, after taking his B.S. in chemical engineering at M.I.T. Two years later he was transferred to the manufacturing manager's office of Pan American Petroleum & Transport Co., becoming its general manager of manufacturing in 1947. After two years he was named president of Pan American Refining Corp.

Dr. J. R. Morris has been transferred to the Port Arthur research laboratories of The Texas Co. as assistant supervisor in chemicals research. He was formerly on the staff of the manager of research at the Beacon laboratories.

Dr. Warren G. Schlinger also has been transferred to Port Arthur. He was working as a chemical engineer at the Texaco research laboratory in Montebello, Calif. He will be a project engineer in fuels research.

James A. Rapalje, a recent graduate of Lehigh University, has joined the Beacon Research Center as an engineer.

Another new employe at Beacon is **Joseph P. Fagan,** who graduated recently with a B.S. in chemistry from Boston College.

Wilbur L. Nelson has been given the 1957 award of merit of the American Association of Cost Engineers. He has been professor of chemical and refinery engineering at the University of Tulsa since 1930.

Englehardt August Eckhardt has been appointed to the National Science Foundation as assistant director for the division of mathematical, physical, and engineering sciences. Eckhardt was formerly vice-president for research at Gulf Research and Development Co. He retired from that post in 1953 and since then has been a consultant for Gulf.

William R. Argyle has been elected president and director of Commerce Oil Refining Co. He retired a year ago as vice-president and manufacturing director of Sinclair Refining Co.

Leonard W. Doolan, Jr., succeeds **H. F. Tomfohrde** as manager of Tidewater Oil Co.'s eastern divisional lubricants supply department. Tomfohrde was appointed manager of the newly created transportation and supply department.

Doolan was previously supervisor of the process section in lubricants supply.

New supervisors have been appointed at the Delaware City refinery. They are designated as shift leaders. The following were transferred last year from the company's Bayonne refinery:

William F. Keating, George A. Koval, George D. Sullivan, John Flynn, Francis L. Dixon, John I. Johnson, Joseph F. Zgola, Leonard P. McCaffery, Patrick J. Reidy, Jr., and **Martin J. Brett, Jr.**

The following were transferred from Tidewater's Avon refinery:

Earl J. Arnold, Richard D. Dodson, Henry J. Kracher, Roy E. Peterson, Donald J. O'Day, John A. Pitts, Jess S. Rightmyer, and **Francis M. Bevan.**

New employes are as follows:

Donald J. Dodd, who was previously head operator of Atlantic Refining Co.'s ammonia plant.

Kelly C. Groseclose, who was at one time an employe at the Standard Oil Co. (N. J.) refinery at Aruba, B. W. I.

William Heilbron, formerly with Sinclair Oil Co. in Venezuela.

James Harkness, formerly with Lago Oil & Transport Co. at Aruba.

Raymond C. Harris, who was with Du Pont Co. as an instrument mechanic.

George Adams has been named operations assistant to Harry A. Brown, vice-president of manufacturing for D-X Sunray Oil Co. He was with Universal Oil Products Co. for eight years before joining D-X Sunray in 1956. He holds a B.S. in chemical engineering from Kansas State College, class of 1948.

Kenneth H. Faulk has been appointed section leader, special products section, of Cities Service Research and Development Co.'s process research lab at Lake Charles, La.

Donald O. Swan has been appointed an assistant general manager of Esso Standard Oil Co.'s manufacturing department. He has been assistant general manager of the Baton Rouge refinery since 1955, and **Robert K. Dix** succeeds him there.

Mr. Swan

In his new assignment Swan will have primary responsibility for specialty products. He was graduated from the University of Minnesota in 1939 with a chemical engineering degree and took a job a few weeks later as a student engineer at Baton Rouge.

J. A. Vickers, president of Vickers Petroleum Co., has been elected chairman of the Governor's Oil Advisory Committee of Kansas. The group will

investigate problems affecting the operation of the Kansas oil industry and report to the Governor.

Jack M. Hazen has been made a chemist in the laboratories of the Vickers Petroleum Co. He is a recent chemistry graduate of Ft. Hays State College.

Juergen J. Bloess and **Mark A. Halepeska** have joined the engineering staff of Great Northern Oil Co. Bloess, formerly a chemical engineer with Humble Oil & Refining Co. at Baytown, has been appointed a process engineer in Great Northern's technical service department. He is a graduate of the Missouri School of Mines.

Halepeska will be a field maintenance engineer for the company. He was graduated from Rice Institute.

O. H. Spittler has been appointed chief laboratory supervisor at the Corpus Christi, Texas, refinery of Delhi-Taylor Oil Corp. He succeeds **H. N. Morrow,** who has joined the company's electronic computer survey team. Since 1952 Spittler has been supervisor of laboratory personnel.

R. Brooks Pietsch has been appointed head of the technical department at Esso Standard Oil Co.'s Baltimore refinery. He succeeds **William F. Robinson,** who is transferring to Esso's Bayway refinery to head the process engineering division. Pietsch has been in Bayway's technical service division.

Theodore A. Mangelsdorf, formerly a vice-president of The Texas Co., has been named a senior vice-president in charge of Texaco's worldwide refining activities.

J. B. Christian has been elected vice-president in charge of Trinidad operations, with headquarters in New York. He was previously chairman of the board and managing director of Trinidad Oil Co., Ltd.

L. C. Kemp, previously general manager of the petrochemical department, has been elected vice-president in charge of that department.

H. A. Hornfelt has been appointed construction superintendent of the British American Oil Co. refinery project at Port Moody. He was construction superintendent during the Moose Jaw refinery expansion beginning in 1951, and most recently was assistant manager of the Calgary refinery.

C. W. Coote has been named manager of the company's projected refinery at Port Moody, B. C. He was formerly manager at the Edmonton refinery.

R. E. Harris succeeds Coote as manager at Edmonton. He was previously assistant manager at Moose Jaw.

J. L. Stoik has replaced Harris at Moose Jaw, where he was operating superintendent.

Dr. Ernest O. Lawrence, director of the Radiation Laboratory of the University of California, has been added to the board of directors of Monsanto Chemical Co. He was added to the board because of the "increasing importance of physics to the field of industrial chemistry," according to President Charles Allen Thomas. Lawrence is a Nobel prize winner in physics (1939).

Harold R. Kemmerer, assistant manager of Shell Oil Co.'s manufacturing research department, has been named manager of the products application department.

Kemmerer succeeds **A. B. Culbertson,** who has retired after 33 years with the company. **J. D. Heldman,** special technologist in the manufacturing operations department, has replaced Kemmerer in the manufacturing research department.

Kemmerer holds a degre in chemistry from Pennsylvania State University. He joined Shell at Wood River, Ill., in 1935.

Culbertson, a graduate of Missouri University, began with Shell in 1923 as assistant chief chemist at Arkansas City, Kan.

• • •

George Gross, staff engineer for Esso Research and Engineering Co., has been appointed manager of a new office being set up in Europe to provide engineering services to Esso affiliates.

George Bauer has been named chief staff engineer for the Western Hemisphere. **Samuel Re,** a staff engineer, has been appointed chief staff engineer for the Eastern Hemisphere. Both are newly created posts.

A. J. Thaman has been named superintendent of the oil movements division at Humble Oil & Refining Co.'s Baytown refinery. **B. D. Jones** has been promoted to assistant superintendent.

The following were promoted in the engineering division:

N. K. Brill to senior maintenance engineer,

G. E. Crist to senior project engineer,

T. R. Herndon and **W. R. Smith** to senior electrical engineer,

W. H. Schweitzer to senior design engineer,

W. F. Tate to senior civil engineer,

E. A. Clarke to senior chemical engineer,

Ralph James, Jr., to supervising engineer.

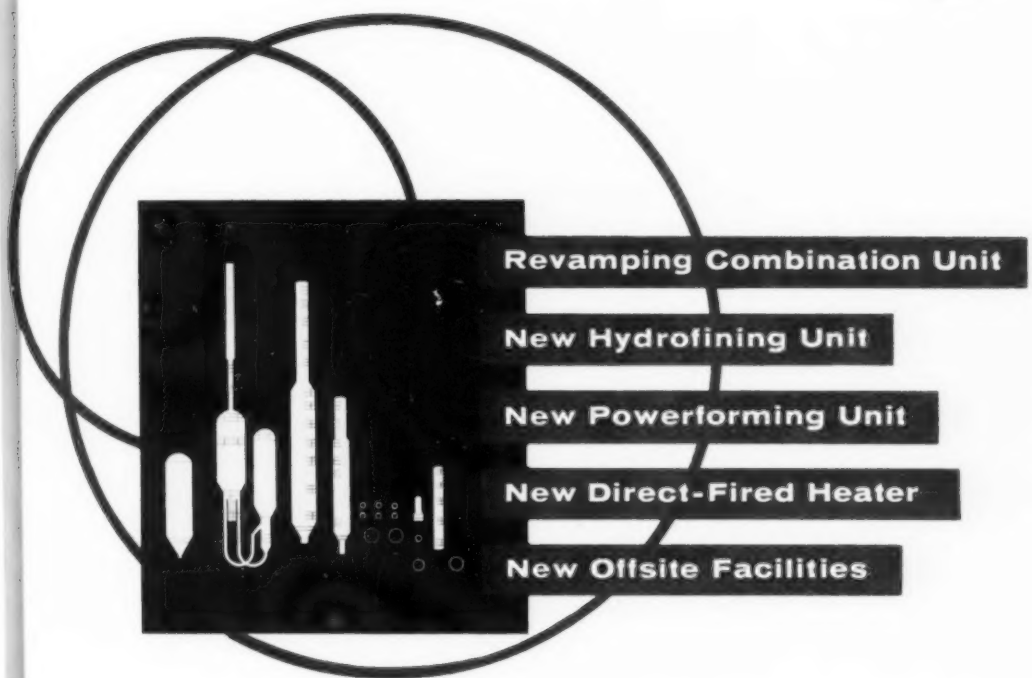
H. Harold Bible has been appointed vice-president and assistant general manager of the Lion Oil Division of Monsanto Chemical Co. He has been director of manufacturing at Lion since 1955.

Bible's responsibilities in the latter post will be taken over by J. B. Rogerson, Lion vice-president of manufacturing, engineering, and development.

Bible joined Lion in 1942. He was previously with Humble Oil & Refining Co. He holds a B.S. in chemical engineering from the 1938 class of the University of Oklahoma.

expansion

at Durban



Foster Wheeler Corporation, builder of the original Durban refinery for Standard-Vacuum Refining Company of South Africa, Pty. Ltd., will design and construct all major process units for this expansion project. The new units and revamping of existing facilities will improve both quality and yield of the refinery's full range of fuel products and asphalts.

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(To obtain more data on advertised products see page 126)

Wire Rope—and Its Uses

What Is It: Wire rope is a flexible, multiple-strand rope made from high-strength, cold-drawn steel wires, and finds many uses as a tension member in hoisting, hauling or supporting loads.

Wire rope is different from wire cable, which is composed of straight strands or twisted elements bound together to form a unit. In a wire rope, the strands (single or multiple wires) are laid helically around a central core, giving it great flexibility.

How Is It Constructed: The basic formation of a wire rope stems from the geometrical relationship of circles. Because one round wire will permit six others of the same size to fit exactly around it, this is the basis for most rope. Variations may be formed by adding successive outer layers of 12 or 18 more wires.

Two types of construction are possible. In *regular lay* the wires are laid in a direction opposite that of the separate strands. For greater flexibility and resistance to abrasion, the wires may be laid in the same direction as the strands—called *lang lay*. If the rope strands are laid in the same direction as the screws of a right-hand thread, the rope is labeled right lay; if similar to a left-hand screw it is called left lay.

The core of a wire rope is the member about which the strands are laid. It may be a fiber, a wire strand or an independent wire rope.

Types of Rope: Because of the many possible combinations of separate wire and strands, over 40,000 different sizes and kinds of wire rope can be made. But most of the common ones are shown below.

Two types of construction fill special requirements. To resist pinching and crushing of wire on a drum, an independent wire core (I.W.R.C.) is used. It also increases the rope's strength by about 7½%. Another special type uses small filler wire between the larger wire to resist abrasion and crushing but still give the desired flexibility.

Designation of a wire rope is by diameter and a series of two numbers. The first designates how many strands in the rope, the second how many wires in each strand. A 6 x 19 rope has 6 strands with 19 wires in each strand.

Materials: Wire ropes are made of many metals, the choice depending on strength and desired corrosion resistance. The majority of ropes are made from grades of plow steel, varying mostly in carbon content and tensile strength:

Improved plow steel	230,000 to 290,000 psi
Plow steel	205,000 to 255,000 "
Mild plow steel	175,000 to 225,000 "

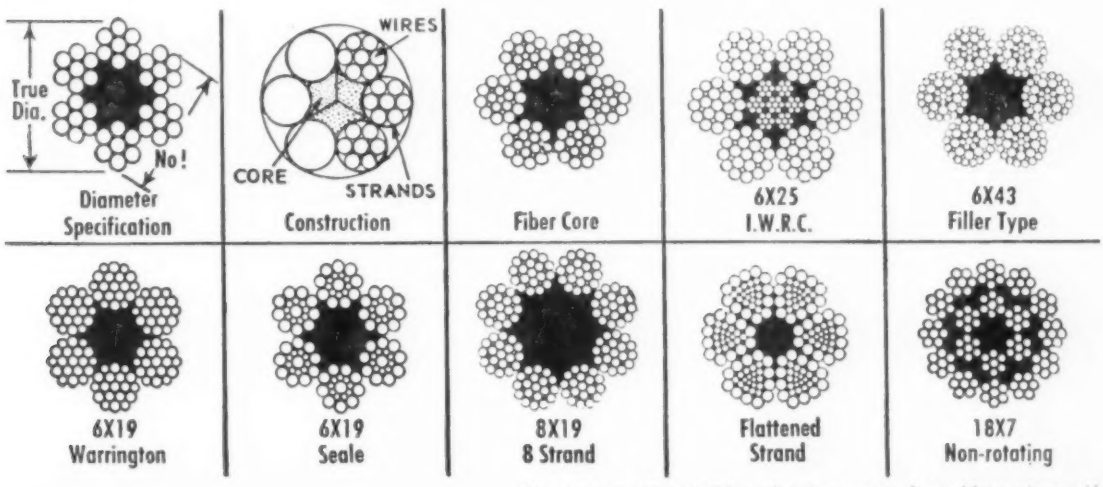
Wire rope of other metals is made for special purposes, including the following:

Cast steel	long fatigue life
Traction steel	elevator use only
Iron	slow speed elevators
Galvanized steel	standing rigging and shipboard
Stainless steel	corrosion resistance
Monel	severe corrosion resistance
Bronze	salt water and low loads

Safety Factor: No wire rope should be loaded near its breaking strength. Most manufacturers recommend a safety factor of five for any running wire rope, with the following variations generally accepted:

	Safety factor of
Guys - derricks	5
" - stacks	3½
Cranes, shovels	5
Overhead traveling cranes	6
Electric and air hoists	7
Derricks	6
Passenger elevators:	
250 ft/min	9
1000 ft/min	11 3/5

Types of wire rope



Turn page for table of wire rope breaking strength

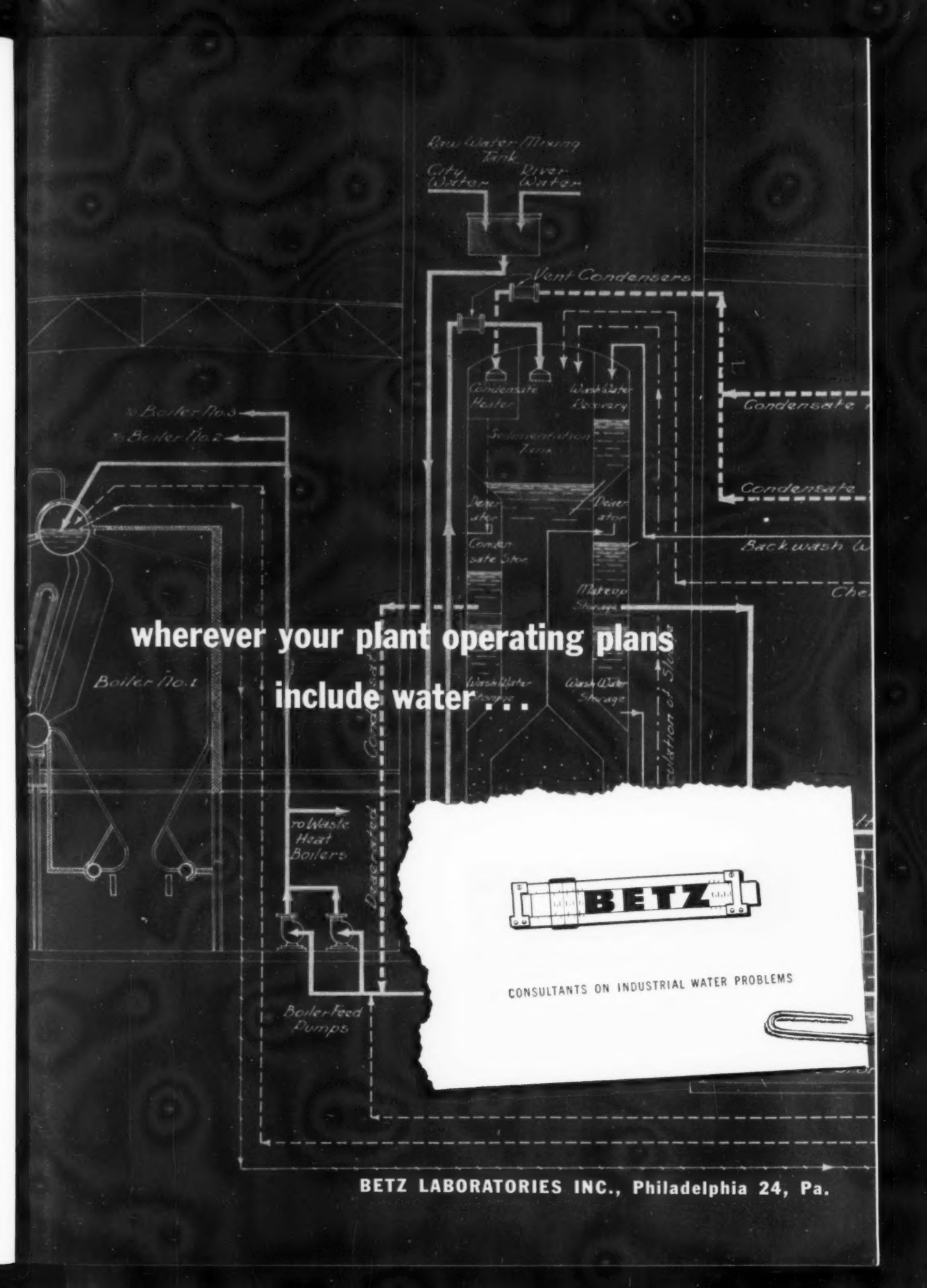
Wire Rope Breaking Strength, in lb

(These values are for fiber core; add 7½% for independent wire core)

Diam.	Improved Plow Steel								Plow Steel					Cast Steel			Iron			Galvanized Steel				Stainless Steel						Monel				Diam.
	6x7	6x19	6x21	6x25	6x30*	6x37	8x19	18x7	6x7	6x19	6x37	8x19	18x7	6x7	6x19	8x19	6x7	6x19	8x19	1x7	1x19	7x7	7x19	1x19	6x7	7x7	6x19	7x19	6x42	6x7	7x7	7x19	6x42	
1/32																								150										1/32
1/16																								375	220	270								1/16
5/32																								500	385	480		480		280	215			5/32
3/16																				400	500 1,200	480 920	1,000	1,200	800	920	740	920		445	490			3/16
1/4		1,390	1,390	1,390																549	2,100	1,700	2,000	2,100	1,400	1,700	1,610	1,730		795	850	875		1/4
5/16		2,170	2,170	2,170																870	3,300	2,600	3,100	3,300	2,100	2,600	1,960	2,600		1,200	1,350	1,350		5/16
3/8		3,000	3,100	3,100																1,150	4,700	3,700	4,200	4,700	3,000	3,700	3,000	3,700		1,800	1,900	1,950		3/8
7/16								4,840												1,540	6,300	4,800	5,600	6,300	4,000	4,800	4,200	4,900		2,400	2,600	2,650	995	7/16
1/2	5,280	5,480	5,480	5,480		5,180	4,700	5,020	4,600	4,780	4,500	4,080		4,000	4,200	3,560	2,000	1,860	1,700	1,900	8,200	6,100	7,000	8,200	5,200	6,100	5,400	6,300	3,200	3,150	3,400	3,500	1,750	1/2
9/16														5,040			2,340			2,570	10,300	7,600	8,900	10,300	6,800	7,800	6,800	7,780		4,000				9/16
5/8	8,200 11,730	8,520 12,300	8,520 12,300	8,520 12,300		8,050 11,540	7,300 10,480	7,800 11,180	7,120 10,200	7,420 10,620	7,000 10,040	6,360 9,100	9,720	6,200 8,600	6,400 9,000	5,560 7,880	2,860 4,100	2,860 4,100	2,500 3,500	3,200 4,250	12,500 17,500	9,200 13,100	9,800 14,400	12,500 17,500	8,000 11,500	9,100 12,600	8,000 10,900	9,000 12,200	4,900 6,900	4,950 7,100	5,300 7,680	5,680 7,050	2,760 3,950	5/8
11/16	15,860	16,540	16,540	16,540		15,560	14,180	15,160	13,800	14,380	13,600	12,340	13,180	11,600	12,000	10,600	5,520	5,520	4,800	5,700	23,400		17,600	23,400	15,400	16,500	15,200	16,300	9,300	9,700		10,700	5,400	11/16
3/4	20,600	21,400	21,400	21,400	23,600	20,400	18,460	19,700	17,920	18,700	17,700	16,040	17,140	15,000	15,400	13,600	7,140	7,140	6,560	7,400	30,300		22,800	29,700	19,800	21,300	21,200	22,050	12,000	12,650		13,950	7,050	3/4
13/16	26,000	27,000	27,000	27,000	29,800	25,800	23,200	24,800	22,600	23,600	22,400	20,200	21,600	18,800	19,200	17,000	8,960	8,980	8,120	9,600			28,500					28,500	15,000	16,050			8,950	13/16
7/8	31,800	33,600	33,600	33,600	36,600	31,600	28,800	30,600	27,800	29,000	27,400	24,800	26,600	23,000	23,600	20,800	11,040		9,720	11,600			35,000					33,800	18,400	19,150		21,800	11,000	7/8
15/16	45,400	47,600	47,600	47,500	52,400	45,200	41,000	43,600	39,600	41,400	39,200	35,600	38,000	33,000	33,600	29,600	15,720	15,720	13,900				48,600					47,800				31,400		15/16
1	61,400	64,400	64,400	64,400	70,600	61,200	55,400	59,000	53,400	56,000	53,200	48,200	51,400	44,800	45,600	40,000	21,000	21,200	18,400				68,500					65,400				42,750		1
1 1/16	79,400	83,800	83,800	83,800	92,000	79,800	72,000	76,800	69,800	72,800	69,200	62,800	66,800	58,000	58,800	52,800	27,400	27,400	24,300			91,600	85,400									55,800		1 1/16
1 1/8	99,800	105,200	105,200	105,200	115,800	100,200	90,800	96,400	88,000	91,400	87,000	78,800	83,800	72,800	74,000	66,800	34,400	34,400				115,000												1 1/8
1 1/4	122,000	129,200	129,200	129,200	142,000	123,000	111,400	118,400	106,000	112,400	107,000	96,800	103,000	89,000	92,000	80,800	42,000	42,000				144,400												1 1/4
1 3/8	148,200	155,400	155,400	155,400	171,000	148,200	134,200	142,600	127,200	135,000	129,000	106,600	124,000	106,000	110,000	97,200	50,400					175,800												1 3/8
1 1/2	172,400	184,000	184,000	184,000	202,000	175,800	158,800	168,800	150,000	160,000	153,800	138,200	146,800	125,000	130,000	115,000	59,400					208,000												1 1/2
1 5/8		214,000	214,000	214,000	236,000	206,000		196,800		186,800	178,600		171,200		152,000							246,000												1 5/8
1 3/4		248,000	248,000	248,000	272,000	238,000		228,000		216,000	206,000		197,600		176,000							286,000												1 3/4
1 7/8		282,000	282,000	282,000		272,000				246,000	236,000				200,000							328,000												1 7/8
2		320,000	320,000	320,000	352,000	308,000				278,000	268,000				228,000							372,000												2
2 1/8		358,000	358,000	358,000		356,000				312,000	300,000				256,000							420,000												2 1/8
2 1/4		400,000	400,000	400,000		386,000				358,000	327,000				288,000							470,000												2 1/4
2 3/8		444,000	444,000	444,000		428,000																522,000												2 3/8
2 1/2		488,000	488,000	488,000		472,000				424,000	410,000				352,000							578,000												2 1/2
2 5/8						520,000																634,000												2 5/8
2 3/4		584,000	584,000	584,000		568,000				508,000	494,000				424,000							694,000												2 3/4
3						672,000					582,000											824,000												3
3 1/2						940,000					780,000																								3 1/2

* 6 x 30 is a flattened strand construction (see other side)

CAUTION: No wire rope should be loaded near the breaking strength. To find the *allowable* load, divide the breaking strength of the wire by the appropriate safety factor (see page 99). The result is the safe allowable lifting load for a specific case.



wherever your plant operating plans include water . . .

BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

BETZ LABORATORIES INC., Philadelphia 24, Pa.

$AlCl_3$

ALUMINUM CHLORIDE

The increasing use of Aluminum Chloride and the many new uses being found for it have led to a large increase in demand. In response to the need, Stauffer has increased production and refining capacity... is today, indeed, the country's largest producer.

PROMPT shipments of Anhydrous Aluminum Chloride are made from Houston, Baton Rouge, Niagara Falls and Elkton, Md., in drums of 600, 100 and 50 pounds net capacity.

Stauffer's Anhydrous Aluminum Chloride is made in granular or powder form, in six grades and numerous mesh sizes. Aqueous Aluminum Chloride is available on the West Coast only. Typical analyses of all grades of Stauffer's Aluminum Chloride comfortably surpass all specifications as to minimum $AlCl_3$ content, and maximum impurities.

Stauffer is also a major source of chlorides of Antimony, Boron, Silicon, Titanium and Zirconium. We shall presently publish a brochure on Metallic Chlorides and shall be glad to supply copies on request.

stauffer means service

Stauffer CHEMICALS SINCE 1885

STAUFFER CHEMICAL COMPANY

380 Madison Avenue, New York 17, N. Y.

Prudential Plaza, Chicago 1, Ill. • 636 California Street, San Francisco 8, Calif.

(To obtain more data on advertised products see page 126)

NEW RESEARCH FACILITIES of the Petrolite Corp. at Webster Groves, Mo., a surburb of St. Louis, to serve the Petreco, Tretolite and Bareco Wax Co. divisions of the company. Research activities will be directed in general toward the development and application of (1) electric-field precipitation for petroleum purification and treating (Petreco Division); (2) chemicals for petroleum purification and treating, including demulsifiers, corrosion inhibitors, and scale preventives (Tretolite Division); and (3) microcrystalline and synthetic waxes (Bareco Wax Co. Division).

Cooper-Bessemer elects top men

Eugene L. Miller has been elected president and general manager of Cooper-Bessemer Corp. Ralph L. Boyer has been elected a vice-president and director of engineering. Robert F. Lay has been elected a vice-president and assistant general manager, and Grant C. Woodard has been made general sales manager.

Miller, 38, is the youngest president in the company's history. After he was made assistant general manager in 1954, the company had the most prosperous years in its history. Miller has initiated a development program for new products in the petroleum and petrochemical industries, as well as important expansion in manufacturing facilities. He became general manager 18 months preceding his latest promotion. Miller holds an M.E. degree from Oklahoma A. & M. College and was employed for a time by Mid-Continent Petroleum Corp.

Boyer, a 1924 graduate of Ohio State University, worked for two years afterward with Dr. Elmer Sperry in the development of the compound diesel engine. He joined Cooper-Bessemer in 1926, became assistant chief engineer in 1929 and chief engineer in 1938. He was made a vice-president in 1947 and a director in 1950.

Lay began with the company in 1946 and later became chief engineer of the products division. Shortly afterward he was appointed assistant general sales manager for all the company's products. In 1955 he became a vice-president and general sales manager.

Succeeding R. F. Lay as general sales manager, Grant C. Woodard moves up from assistant general sales manager, a post he assumed in 1955. He is a graduate in mechanical engineering from Cornell University, class of 1948, and began with the company the same year.

Landis to be ASME head

James N. Landis, a vice-president of Bechtel Corp., San Francisco, has been nominated to the presidency of the American Society of Mechanical Engineers. He will take office next December after a mail ballot of ASME members.

Other officers nominated included:

Ernest W. Allardt, chief engineer, Babcock & Wilcox Co., Tubular Products Division, nominated vice-president of Region V.

Elmer O. Bergman, staff consultant, C. F. Braun & Co., nominated director of codes and standards.

Ronald B. Smith, vice-president, M. W. Kellogg Co., nominated director of technological activities.

Alkali sales unit at Jefferson

Jefferson Chemical Co. has formed a new alkali sales division to market caustic formerly handled by its parent company, American Cyanamid Co. The new division is headed by William F. Phillips, formerly with American Cyanamid. Others who handled these products at the latter company have also transferred to Jefferson.

The move is being made as a forerunner to the opening of caustic soda production at Jefferson's Port Neches chlorine plant, scheduled for completion in 1958.

American Cyanamid and The Texas Co. own Jefferson.

Lummus sells division

The heat exchanger manufacturing division of The Lummus Co. has been sold to Yuba Consolidated Gold Fields. The division operates a plant located at Honesdale, Pa., and the transaction is part of Lummus's announced plan to concentrate on its engineering and construction activities.

Yuba has assumed all of the division's contracts and the purchase will enlarge its heat exchanger activities, until now primarily servicing the chemical and petroleum industries.

George Worn, for many years a Lummus employe in the heat transfer field, and other Lummus employes, have transferred to Yuba.

Rice made F&P sales manager

Robert L. Rice has been promoted to general sales manager of Fischer & Porter Co. He has been manager of the water and waste division for the past three years. He will direct the sales efforts of all four divisions of the company: industrial instruments, data reduction and automation, precision glass, and water and waste.

Mr. Rice

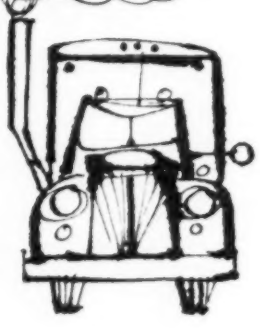
Rice joined the company in 1950 as a sales engineer. A year later he was made sales manager of the Cincinnati office. He holds a B.S. in mechanical engineering from the University of Cincinnati.

Fino made Hammond chief engr.

Alex F. Fino has been appointed chief engineer of the Hammond Iron Works. He has been with Hammond since 1940 and has had principal responsibility for design and development of some of the company's best-known oil conservation devices.

He holds a B.S. in mechanical engineering from the University of Pitts-

pull more diesels to your pump – deliver full power without noxious exhaust odors – just add Alamask® to your diesel fuels



It takes very little Alamask to subtract the choking odor from diesel exhaust fumes while adding to your sales. Alamask in your fuel will pull truckers, bus operators to your pump. *Selling point to truckers:* operators who tank up with your odor-controlled diesel fuels avoid the increasing demands to "put a stop to engine odors or reroute your lines." *Selling point for buses:* lines that standardize on your odor-controlled fuel increase passenger comfort both in the vehicle and in the terminal – builds good will all along the route. Why not call us about adding Alamask to your diesel fuels? Let us show you how Alamask can give you a new competitive plus.

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(PHONE PL. 3-4850) REPRESENTATIVES IN:
PHILADELPHIA · CINCINNATI · CHICAGO
DENVER · LOS ANGELES · MONTREAL · MEXICO CITY

burgh and is active with the American Petroleum Institute, American Welding Society and American Society of Mechanical Engineers.

Kline promoted at Blaw-Knox

George F. Kline has been named assistant manager of the petroleum department, within Blaw-Knox Co.'s chemical plants division. He began with the company in 1954 after three years as chief process engineer of the Vulcan Engineering Division. Prior to that he was with Stacey Bros. Gas Construction Co. and Hydrocarbon Research, Inc.

Mr. Kline

During the second World War Kline was assigned to Oak Ridge, Tenn., with the Corps of Engineers and served there in various operating and administrative capacities.

He holds a B.S. in chemical engineering from Cooper Union and a master's degree in the same subject from New York University.

Company sues former employe

Young Radiator Co., Racine, Wis., has filed a suit against a former divisional sales manager for allegedly using its confidential design data, engineering drawings, and price lists to set up and market a competing line of products. Defendants are Hiram J. Kinkade and the Perfex Corp., where Kinkade is currently employed as a divisional manager.

The dispute centers around air cooled-type coolers and condensers for the oil and chemical fields, products of the Young company since 1937. The case is pending in a Milwaukee County Circuit Court.

Outcome of the case will be watched with interest for its bearing on other situations of this sort in industry.

SD opens first catalyst plant

The northern New Jersey catalyst plant constructed by Scientific Design Co. has begun operations with the manufacture of silver catalyst for the SD ethylene oxide process. This catalyst will be furnished to General Aniline & Film Corp.'s plant now under construction at Linden, N. J.

Scientific Design first began to develop the catalyst 11 years ago. In 1953 it was made in commercial quantities in cooperation with Napthachimie in France.

The new SD plant is a single-story building containing 8500 sq ft of space. Every step in the manufacturing process is completely instrumented, and the design permits a doubling of capacity.

SD's venture into catalyst manufacture is under the direction of Dr. Alfred Saffer, assistant vice-president.

Three promoted at CB&I

Fred L. Goldsby, vice-president and formerly general sales manager, has been appointed assistant to the president of Chicago Bridge & Iron Co.

S. C. Hamilton, who was previously district sales manager in Houston, has been made a vice-president and general sales manager, with headquarters in Chicago.

K. W. Lange has replaced Hamilton as Houston district sales manager. He was in the San Francisco sales office.

Personnel changes

International Nickel Co.—Dr. Thomas P. May has been appointed manager of the Kure-Beach-Harbor Island testing station in North Carolina. He combines his former duties as technical manager of the station with those of resident operational manager, relinquished by the late Harry T. Paterson.

Baldwin-Hill Co.—J. Alfred Rigby, Jr., has joined the company, transferring from Hunter-Bristol Corp., where he was a vice-president. Baldwin-Hill has arranged to manufacture and distribute Hunter's aluminum thermal insulation, and Rigby will continue to merchandise and market it.

Branches, distributors

Hills-McCanna Co. has appointed Republic Supply Co. of Calif., 1919 Williams St., San Leandro, exclusive stocking distributor for diaphragm valves and parts in northern California and western Nevada.

Schutte and Koerting Co. has appointed Leo Johns sales representative in Oklahoma and sections of Arkansas and Texas. Johns is at P.O. Box 5348, Tulsa.

ALCO Products, Inc., has appointed Walter W. Perkins of Los Angeles exclusive agent in Southern California for heat exchangers and other fin-tube products. Perkins has an office at 1266 South Boyle Ave.

 (To obtain more data on advertised products see page 126)

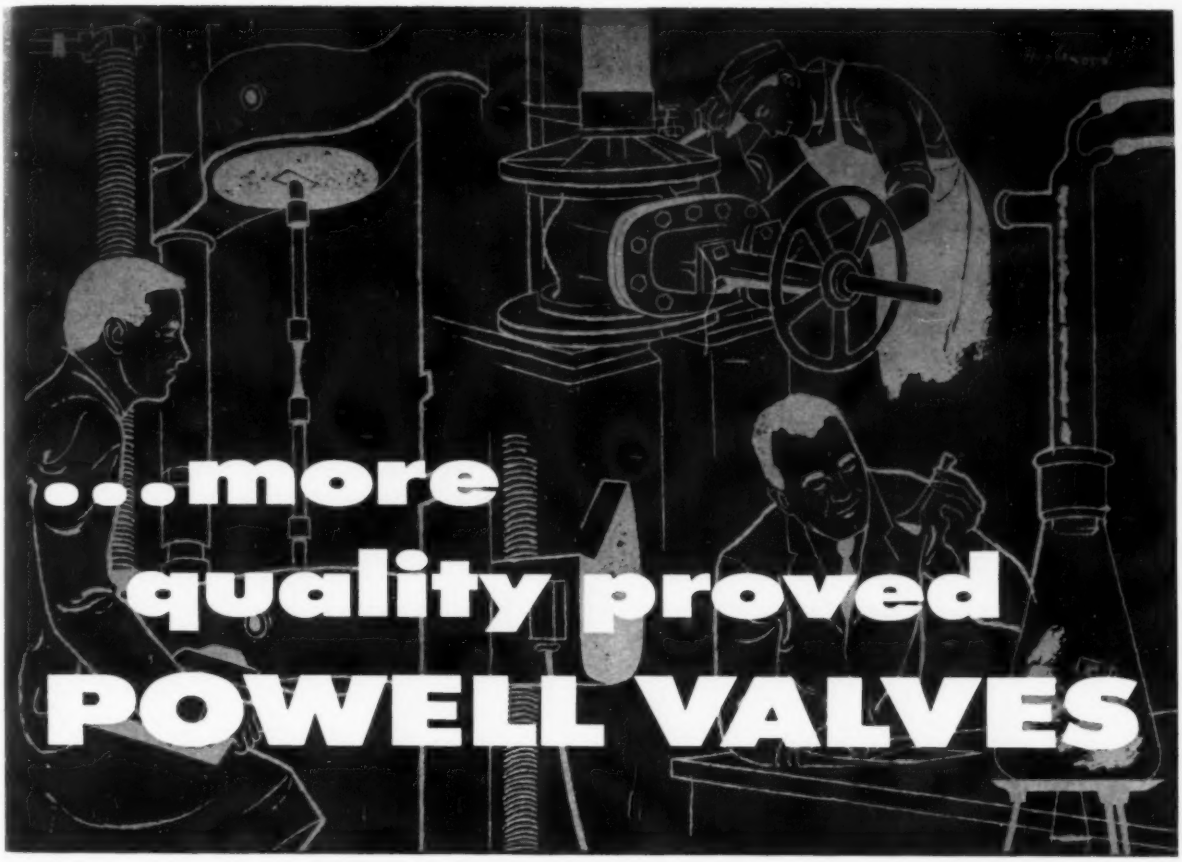
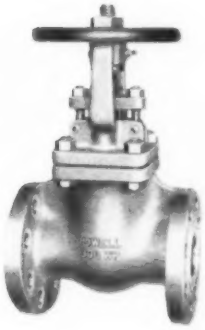


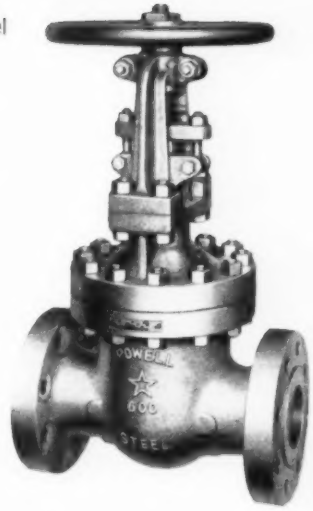
FIG. 375—Bronze "White Star" Gate Valve for 200 pounds W.S.P.

FIG. 2467—Stainless steel O.S. & Y. Gate Valve for 300 pounds W.P.

FIG. 6003—600-pound Steel O.S. & Y. Gate Valve

FIG. 3061—300-pound Steel Swing Check Valve



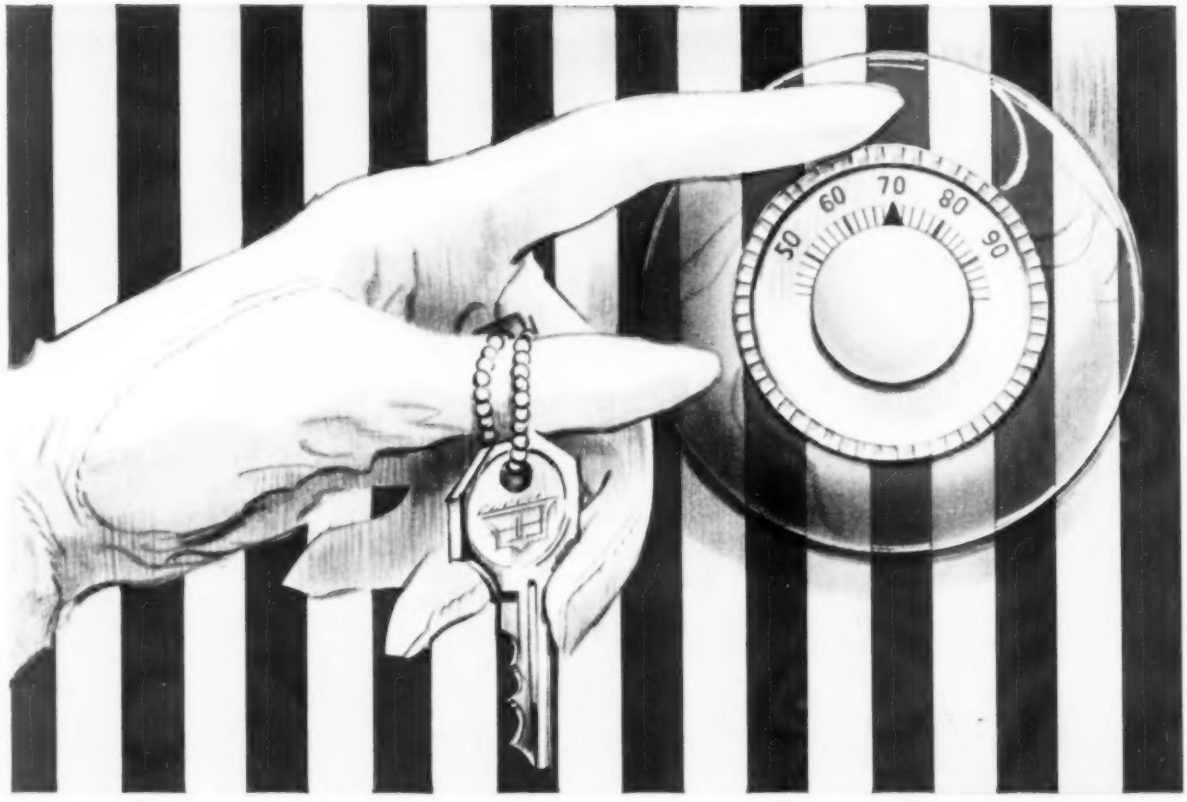


for dependable flow control

Consult your Powell Valve distributor for full facts about quality proved bronze, iron, steel and corrosion-resistant valves. For every flow control problem—there is a Powell Valve to solve it.

THE WM. POWELL COMPANY, CINCINNATI 22, OHIO . . . 111th YEAR

 (To obtain more data on advertised products see page 126)



CLEAN-burning...

a heating oil sales feature that can make you extra profits... save you money... increase customer satisfaction

In today's highly competitive fuel oil market, you can gain three distinct advantages by using Du Pont Fuel Oil Additive No. 2 (FOA-2):

1. Win new customers
2. Save money on expensive contract service calls
3. Increase customer satisfaction

Here's why

FOA-2 contributes to clean burning by minimizing deposits in fuel systems. So, by advertising and promoting oils that will stay clean, you will attract new customers who are tired of oil that causes stoppages.

Sludge-free furnace oil means no clogging of filters, strainers, nozzles and other burner parts. Burners stay in adjustment longer and fewer service calls are required.

Dispersant action

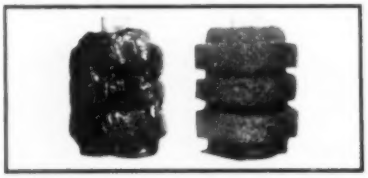
Du Pont FOA-2 is also a dispersant and solubilizer. Over a period of time, it reduces pre-formed deposits throughout entire systems.

Ashless

FOA-2 burns completely, without leaving any ash to interfere with the operation of ignition and stack controls. Because of this, it helps reduce chimney deposits and the possibility of puff-backs.

For best results, Du Pont FOA-2 should be added to freshly prepared stocks *at the refinery*. Small amounts are enough to protect most stocks from sludge... insure cleaner burning... reduce deposits in heating systems... prevent nozzle and filter fouling... and *keep* the systems clean.

E. I. DU PONT DE NEMOURS & CO. (INC.)—Petroleum Chemicals Division—Wilmington 98, Delaware.



Just look at the difference! Filter on left was used for 90 days with untreated fuel. Filter on right was used for 90 days with same fuel to which FOA-2 had been added.

DU PONT

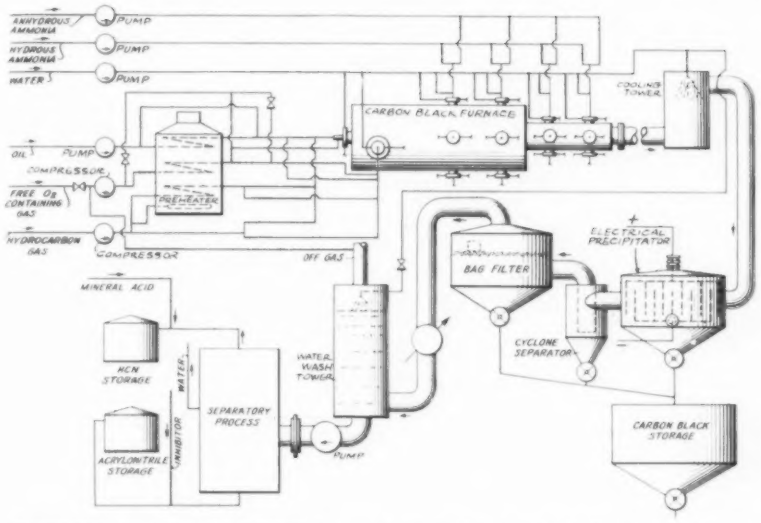
Better Things for Better Living ... through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & CO. (INC.) · Petroleum Chemicals Division · Wilmington 98, Delaware

PATENTS

By ROBERT L. DAVIDSON, Associate Editor



CARBON BLACK PROCESS adapted to make acrylonitrile and hydrogen cyanide by the injection of ammonia into reactor gases

Carbon black process produces . . .

Acrylonitrile and Hydrogen Cyanide

CARBON black is produced as solid particles suspended in a hot effluent gas containing carbon monoxide, hydrogen, and sometimes acetylene. According to Phillips Petroleum Co. (U.S. Patent No. 2,796,327), this gas contains sufficient amounts and proper proportions of gases of the right chemical composition, together with sufficient heat, to support an endothermic reaction with an ammonia-containing fluid to produce hydrogen cyanide and often acrylonitrile. Economical, commercial amounts of these chemicals are claimed in the patent.

In essence the process, as shown by the flow diagram, comprises completely burning a hydrocarbon with a free-oxygen containing gas in a carbon black furnace. An effluent smoke of carbon black solid particles is formed, suspended in a gas of hydrogen, carbon monoxide, and water vapor. Ammonia is injected to react with the carbon monoxide, forming hydrogen cyanide.

Some of the hydrogen cyanide formed reacts with acetylene formed in the reaction, thus producing acrylonitrile.

A typical example is given for the process, wherein a refractory, aromatic-containing gas oil and methane is the feedstock. When using oxygen as the oxygen containing gas, 0.4-2.5% of the gas formed is acrylonitrile and 0.6-4% is hydrogen cyanide. If air is used as the oxygen containing gas, proportions of acrylonitrile and hydrogen cyanide are 0.2-1.5% and 0.3-2%, respectively.

Congress slowdown stymied patent progress

CONGRESS will not do much in this session to help the machinery of the Patent Office, creaking under a current backlog of over 217,000 pending patent applications.

Remedial legislation has not even reached the hearing stage in congress—certainly will not pass in this session. An appropriation increase of about $2 million over last year covers only the addition of more patent examiners and continuing experiments in mechanization for patent classification.

Three of the stymied patent bills, jointly sponsored by Senators O'Mahoney (D.-Wyo.) and Wiley (R.-Wis.) are:

- Increase membership of Board of Appeals in the Patent Office from nine to fifteen members, and raise the salaries of the Commissioner of Patents and all Patent Examiners-in-Chief.
- Establish the Patent Office as an independent agency, separate from the Commerce Dept.
- Limit the life of a patent to a maximum of 20 years from the date it was applied for or 17 years from the date it was issued, whichever is shorter, to eliminate stalling tactics.

Senator O'Mahoney is also the sponsor of another proposal, the so-called "Publication Bill," to permit publication by the Patent Office—at the discretion of the inventor—of patent applications, without the grant of the usual monopoly. This bill is aimed at cutting down on "defensive patenting" supposedly used widely by many large corporations.

Patent Office needs patent examiners

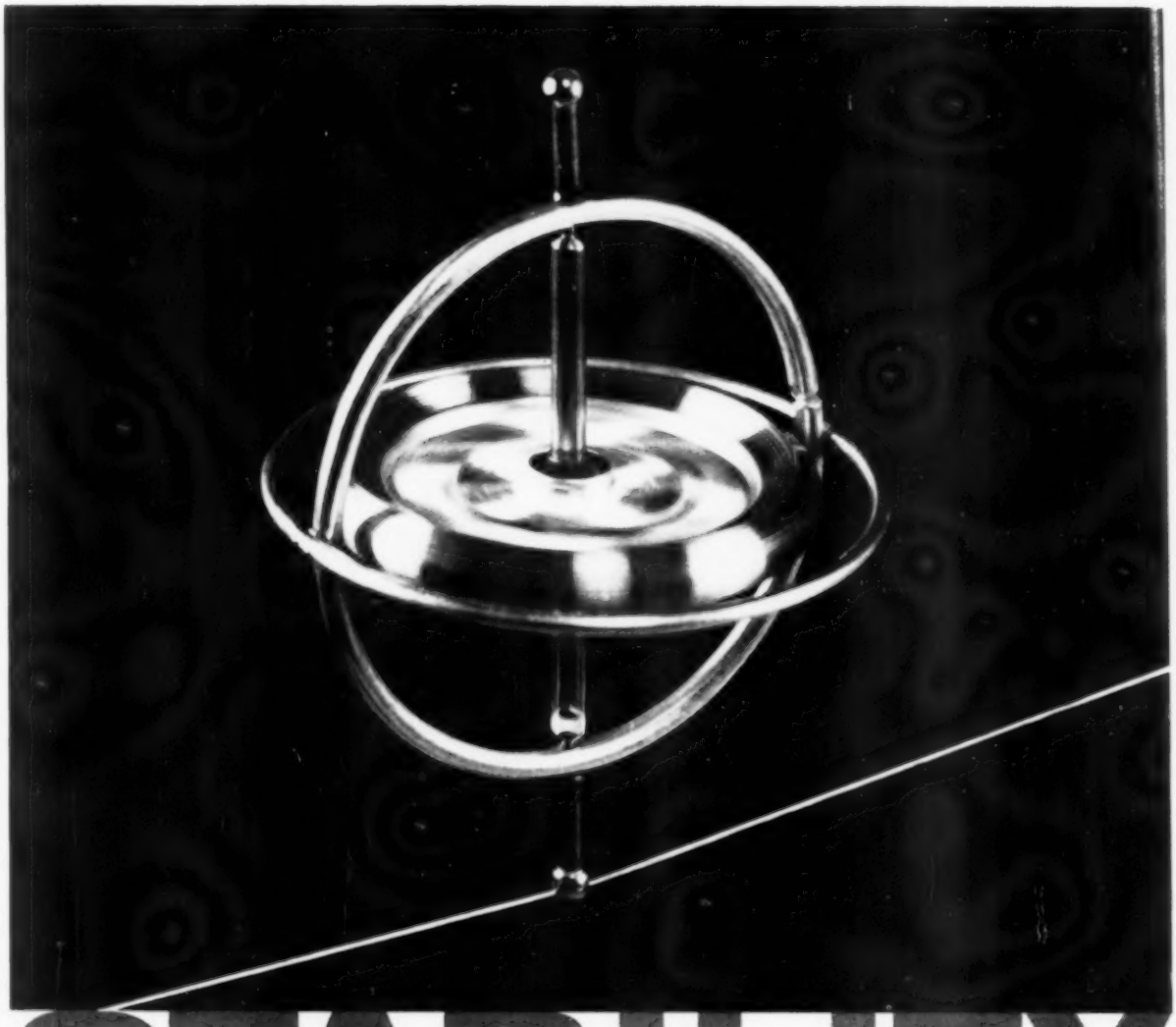
The Patent Office still is desperately in need of engineers and scientists to serve as patent examiners, according to the New York Patent Law Association. While there are openings in all areas, electrical engineers and electronics specialists are particularly needed.

Men and women holding degrees in engineering or applied science, or a degree with a major in chemistry or physics, or with certain combined credits in these fields, are eligible for appointment as patent examiners, without examination, upon application to the Commissioner of Patents in Washington, D.C.

Under the revised salary schedule, the minimum starting salary is $4,480 per year, and after three months' service, promotion to $5,335 may be expected—based solely on ability and work performance. A higher starting salary of $5,335 (with an expected increase to $6,250 nine months later) is for applicants with as little as six months professional experience in engineering, chemistry, physics, or patent law.

Normally, an examiner earns $8,215 per year in less than five years after graduation from college, with additional opportunities for promotion up to $13,760 per year.

Continued on p. 111



STABILITY

CONSIDER QO FURFURAL'S FINE RECORD OF STABILITY IN REFINING OPERATIONS

QO Furfural has a high degree of stability under conditions encountered in petroleum refining. This stability is clearly demonstrated by long continuous operation and by the low solvent losses in operating units.

Furfural losses of less than 0.02% of the solvent cycled are reported by several lube refiners. In a somewhat similar operation, extractive distillation of butadiene, furfural losses are reported to be between 0.01 and 0.02% of the total circulated.

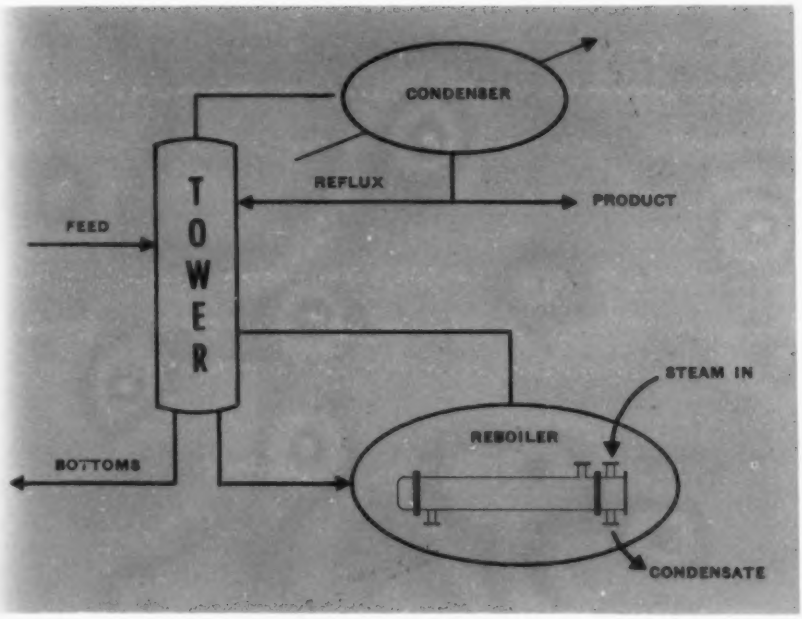
One furfural lube refining unit made a run of 27 months duration and is now on an 18-month turnaround schedule. Solvent stability makes this fine record possible.

WRITE FOR BULLETIN 203A—PHYSICAL PROPERTIES OF QO FURFURAL

The Quaker Oats Company
CHEMICALS DEPARTMENT

339J The Merchandise Mart, Chicago 54, Illinois
Room 539J, 120 Wall St., New York 5, N. Y.
Room 439J, 48 S. E. Hawthorne Blvd., Portland 14, Oregon

In the United Kingdom: Imperial Chemical Industries, Ltd., Billingham, England. **In Europe:** Quaker Oats-Graanproducten N. V., Rotterdam, The Netherlands; Quaker Oats (France) S. A., 3, Rue Pillet-Will, Paris IX, France; A/S "Ota", Copenhagen, S. Denmark. **In Australia:** Swift & Company, Ltd., Sydney. **In Japan:** F. Kanematsu & Company, Ltd., Tokyo.



WOLVERINE TRUFIN® DOES IT AGAIN

REDUCED TUBE CLEANING FREQUENCY BOOSTS BUTANE REBOILER EFFICIENCY

BY ERNEST DODD

Because of their enthusiasm, Texans undergo a great deal of teasing. But there's one thing that's sure. Show a Texan a product that can help him do a better job and he'll put it to work—*but fast.*

Such a product is Wolverine Trufin Type S/T—the integrally finned condenser tube. Here is the story of how process engineers in a certain Texas refinery are using this extended surface tubing to increase butane reboiler efficiency.

Slightly more than a year ago, these engineers placed on stream, a reboiler with steam on the tube side and butane, containing a fairly large amount of pentanes, on the shell side. The unit was tubed with 384 pieces of Trufin Type S/T condenser tube which, because of its increased surface, enabled the refinery to handle the reboiling of this mixture by using steam at atmospheric pressure.

During the first month of operation, overall heat transfer coefficients were taken. However, these coefficients appeared so high for the mixture involved, that the engineers stopped taking data and decided to see what the overall operation would be over a longer period of time.

From previous experience, the engineers knew that when the unit was tubed with plain tube it was necessary, after approximately a year, to increase steam pressure by 75 or 80 pounds to accommodate the heat load. However, as the months rolled by, the reboiler continued to operate at atmospheric pressure. Furthermore, it had always been necessary, after a year of operation, to pull the plain tube bundle for cleaning.

The Trufin-tubed unit showed no indication of requiring cleaning. Indeed quite the contrary is true, the interpretation of their own data has convinced the engineers that it will not be necessary to clean the shell side of this unit for an indefinite period.

Since the object of retubing with integrally finned tubing was to increase on stream time, the conclusion of these processing engineers is that Wolverine Trufin Type S/T has amply proved its ability to withstand fouling in this type of operation for longer periods than does prime surface tubing.

TYPE S/T AT HOME IN OLD OR NEW UNITS

Wolverine Trufin Type S/T is a completely versatile condenser tube—equally at home, in new units or old. When new heat exchangers and condensers are designed around Wolverine Trufin Type S/T, they are smaller and more compact because Trufin's integral fins increase heat transfer surface—extract more BTU's per foot of tube. The result is a substantial saving in direct tube costs as well as in labor and the materials that go into headers, baffles and shells.

When used for retubing purposes, Type S/T steps up the capacity of existing equipment because its greater surface area packs more heat transfer surface into the same size shell.

Also of major importance when retubing, is the fact that Trufin Type S/T is completely interchangeable with the plain tube it is designed to replace. During the finning process the ends of the tube are left without fins and the tube is designed so that the O. D. of the plain end is slightly larger than the O. D. over the fins.

Because of this, Trufin can thus be inserted into the bundle and rolled directly into the tube sheet in the regular manner using standard retubing techniques and tools.

TECHNICAL HELP FROM FIELD ENGINEERING SERVICE

Always available to help customers solve problems in alloy selection, design and corrosion, etc., are the skilled members of Wolverine's Field Engineering Service. Their services are yours without obligation. Call on them next time you need help.

SEND FOR THIS FREE BOOK

Wolverine's condenser tube catalog is a ready source of information for those engaged in the field of heat transfer. In addition to descriptions of Wolverine's complete condenser tube lineup this valuable book also has sections on alloys, specific tubing applications, the effects of corrosion on various metals, etc. This handy reference book is yours absolutely free. Write for your copy

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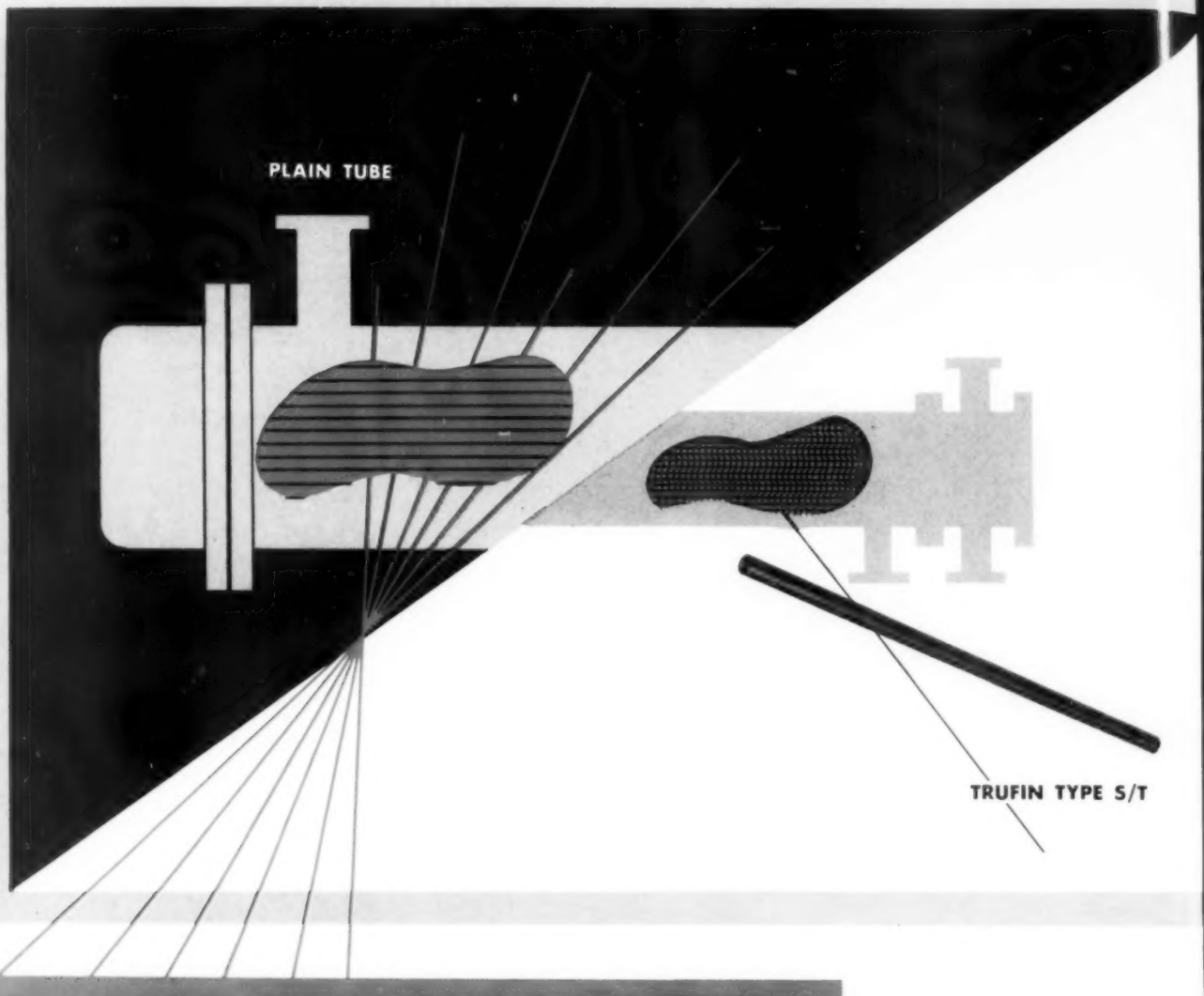

DON'T DESIGN IN THE DARK

With the development of Wolverine Trufin Type S/T —the integrally finned condenser tube—a new day has dawned for designers and fabricators of heat transfer equipment.

Now it is possible for engineers to design lower cost heat exchangers. All that is necessary is to design around integrally finned Trufin Type S/T—rather than around plain tube. Trufin, you see, has integral fins which are actually squeezed from the tube wall. The result is more heat transfer surface per foot of tube which, of course, means greater BTU extraction.

Because of its integral fins Trufin Type S/T, for example, actually has more than 2½ times as much surface area as a piece of prime surface tube of comparable diameter and length. *This is equivalent to an overall increase in surface area of 150%.*

If you are designing new equipment—or retubing old —why not let Wolverine Trufin Type S/T help you shed new light on your problems. For more detailed information write for your copy of the Trufin Catalog.

Wolverine Trufin is available in Canada through the Unifin Tube Co., London, Ontario.

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THE FOLLOWING PATENTS are selected from the Official Gazette of the U.S. Patent Office for May 28, Vol. 718, No. 4; and June 4, 11, 18, Vol. 719, Nos. 1, 2, 3. Copies of patents are available for 25¢ each. Order by patent number from the Commissioner of Patents, Washington, D.C.

Processes and methods

FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT NO.
Additive Sweetening	light hydrocarbon oils	phenylenediamine oxid. inhib.	The Texas Co.	2,796,384
Aromatization	naphthas	catalytic process	Gulf Research & Development Co.	2,794,841
Cat cracking	gas oils	pre-treatment of org. N cmpds.	Standard Oil Co. (Ind.)	2,796,387
	hydrocarbons	hydrogen donor diluent	Esso Research & Engrg. Co.	2,796,386
Cat polymerization	olefins	nickel sulfate-containing cat.	Phillips Petroleum Co.	2,794,842
Cat reforming	hydrocarbon	chromia-alumina base catalysts	Standard Oil Co. (Ohio)	2,796,410
	hydrocarbons	granular reforming catalysts	Socony Mobil Oil Co., Inc.	2,795,533
Coking	heavy oils	dense fluidized coke bed	Esso Research & Engrg. Co.	2,796,391
Conversion	carbonaceous materials	formation of CO & H_2 gas mix	The Texas Company	Re 24,328
	heavy hydrocarbon	coking in gran. contact matl.	Socony Mobil Oil Co., Inc.	2,794,771
	heavy residues	formation of volatile products	Esso Research & Engrg. Co.	2,793,987
Demethylation	CH_3-substituted aromatics	alumina-silica catalysts	Socony Mobil Oil Co., Inc.	2,795,633
Disproportionation	alkylaromatics	formation of C_6H_6 & xylenes from toluene	Houdry Process Corp.	2,795,629
Eradication	nematodes in soil	sulfenyl xanthates	Phillips Petroleum Co.	2,795,525
Filtration	lube oils	reduction of neut. value	Pure Oil Co.	2,795,535
Gasification	coal	pebble heating chamber	Phillips Petroleum Co.	2,794,724
Gellation	liquids	oil-soluble, saturated hydrocarbon sulfonyl chloride	Esso Research & Engrg. Co.	2,794,003
Hydrodesulf.	hi-boiling hydrocarbon	regenerable, suspended catalyst	Gulf Research & Development Co.	2,794,766
Hydrogenation	carbon monoxide	molybdenum (III) oxyphosphate cat.	Du Pont	2,795,561
	kerosine	removal of color & fluorescence	Phillips Petroleum Co.	2,793,986
Lubricant	oleaginous material	extreme pressure properties	The Texas Company	2,796,402
Manufacture	acrylonitrile	hydrogen cyanide & acetylene	Montecatini	2,796,426
	aliphatic nitriles	aliphatic acid-ammonia reaction	B. F. Goodrich Co.	2,794,043
	ammonia synthesis gas	oxidation of hydrocarbons	The Texas Company	2,795,558-9
	ammonium sulfate	formation of double salt of calcium & ammonium sulfate	Shell Development Co.	2,795,486
	ammonium sulfate	spray saturator	Carl Otto	2,795,487
	aromatic isocyanate	primary monoamine & phosgene	Du Pont	2,795,597
	C_nH_n dicarboxylic acids	oxid. of lower alkylbenzene nitrile	California Research Corp.	2,795,599
	carbon black	production of synthesis gas	Phillips Petroleum Co.	2,796,332
	carbon black feedstock	ult. conv. to carbon black	Phillips Petroleum Co.	2,794,710
	catalyst	silica-magnesia composition	Socony Mobil Oil Co., Inc.	2,796,409
	catalyst	molybdenum oxide & alumina	M. W. Kellogg Co.	2,794,005
	catalyst	solid siliceous hydrogel	Universal Oil Products Co.	2,794,002
	CO-H_2 gas mixtures	fluidized carbonaceous solids	Esso Research & Engrg. Co.	2,794,725
	cyanogen	reaction of water & HCN	Pure Oil Co.	2,793,991
	desulf catalysts	F-promoted, Co-molybdate	British Petroleum Co. Ltd.	2,793,984
	emulsifier	mineral-oil-soluble properties	Nopco Chemical Co.	2,794,000
	furnace carbon black slurries	desired physical properties	Phillips Petroleum Co.	2,794,749
	hard, flexible product	vinyl halide polymer-liquid polyepoxide composition	Shell Development Co.	2,795,565
	hydrogen cyanide	prod. of carbon black & acrylonitrile	Phillips Petroleum Co.	2,796,327
	hydrogen rich gas	removal of carbon contained	M. W. Kellogg Co.	2,793,938
	ketones	dehydrogenation of sec. alcohols	Esso Research & Engrg. Co.	2,794,053
	methyl mercaptan	H_2S-methanol-methyl sulfide react.	Dow Chemical Co.	2,796,438
	monovinyl acetylene	low conv. of acetylene per pass	Du Pont	2,796,448
	nitriles	vapor-phase react of prim alcohol & NH_3	Union Carbide & Carbon Corp.	2,795,600
	oxygenated organics	Oxo process for olefins	Esso Research & Engrg. Co.	2,796,436
	petroleum pitch	vacuum & steam dist. of crude oils	Gulf Research & Development Co.	2,796,388
	phenylethylene glycol	cat. hydrog. of styrene peroxide	General Electric Co.	2,794,055
	secondary alkyytoluene	anhydrous condition reaction	Standard Oil Co. (Ind.)	2,795,632
	synthetic drying oils	poly. of butadiene fractions	Esso Research & Engrg. Co.	2,795,631
	synthetic lube	crude alcohol-olefin-CO-H_2 react.	Esso Research & Engrg. Co.	2,796,441
	terephthalic acid	cat. heat of alk. metal benzoate	Henkel & Cie. G.m.b.H.	2,794,830
	tertiary hydroperoxides	oxid. of aromatic hydrocarbons	Imperial Chemical Industries Ltd.	2,796,439
	trialkylbenzenes	alkyl group transfer	Standard Oil Co. (Ind.)	2,795,630
	vinyl esters	acetylene & monocarboxylic acid	Monsanto Chemical Co.	2,794,827
Polymerization	acetylene	cuprous oxide catalyst	Air Reduction Co.	2,794,784
	olefins	group V metal oxide & alk. metal	Standard Oil Co. (Ind.)	2,795,574

Continued on page 112

Patents (continued)

FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT NO.
Preparation	lube oil stock	resistance to oxidation	Pure Oil Co.	2,793,982
Production	naphthas	doctor-sweet, non-corrosive prop.	Pure Oil Co.	2,793,983
Purifying	spent sulfuric acid	phenolic solvent	Esso Research & Engrg. Co.	2,794,704
Recovery	propane	refrigerated separation columns	C. F. Braun & Co.	2,794,334
	shale oil	elongated vert. retorting chamber	Socony Mobil Oil Co., Inc.	2,796,390
	xylene	dist. from dimethyl terephthalate	Du Pont	2,795,537
Reduction	aromatic nitrogen cmpds.	reducing sugar & caustic alkali	Allied Chemical & Dye Corp.	2,794,047
Refining	heavy mineral oil	anhydrous mix of NaOH & KOH	Sun Oil Co.	2,795,532
Regeneration	aq alk. metal OH	electrolysis epoxides	Sun Oil Co.	2,794,768-9
	aq alk. metal OH	oxygen containing gas	Socony Mobil Oil Co., Inc.	2,796,385
Removal	sulfur from distillate	caustic solution & regeneration	Universal Oil Products Co.	2,794,767
Separation	crystals	tangential vortex zone	Shell Development Co.	2,794,832
	gaseous components	fluid adsorption char	Esso Research & Engrg. Co.	2,793,713
	heat-sensitive liquid	centrifugation chamber	Shell Development Co.	2,796,389
	hydrocarbon types	azeotropic distillation	Phillips Petroleum Co.	2,794,773
	iso- & terephthalic acids	N,N-di (lower alkyl) formamide	Union Oil Co. of California	2,794,831
	materials	fractional crystallization	Phillips Petroleum Co.	2,794,840
	xylenes	recovery of para- & ortho-xylenes	Standard Oil Co. (Ind.)	2,795,634
Stabilization	cracked dist. fuel oils	alc. & alk. metal hydroxide	California Research Corp.	2,794,770
Storage	acetylene	dialkylcyanamide solvent	Phillips Petroleum Co.	2,795,322
Sweetening	cracked naphthas	aqueous caustic solution	Standard Oil Co. (Ind.)	2,795,531
	mercaptan-bearing oils	treated adsorbents	Phillips Petroleum Co.	2,793,985
Treatment	ammonium nitrate	cond. products to stop caking	Imperial Chemical Industries Ltd.	2,794,701

Products

Fuel oil	distillate fuel oil	primary, n-aliphatic monoamines	Socony Mobil Oil Co., Inc.	2,793,943
Gasoline jelly	gasoline	Al. oleic & dibasic acid soaps	Emery Industries, Inc.	2,795,492
Grease	lube oil	metal soap & fatty acid	Esso Research & Engrg. Co.	2,795,546
Insecticide	liquid carrier	sub. epoxy & epithia dimetha-nonaphthalenes	Universal Oil Products Co.	2,793,975

Continued on p. 114

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FLOW INDICATOR
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For high pressures and hazardous fluids...No contact with glass
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There's not a single stuffing box, yet this Model 3602 Armoured Flow Indicator handles pressures to 3000 psig; temperatures to 500° F. Eight ranges cover flows from 1.5 to 1200 GPH water. It's all metal with a positive-bond magnetic indicating follower and only 7 inches high.
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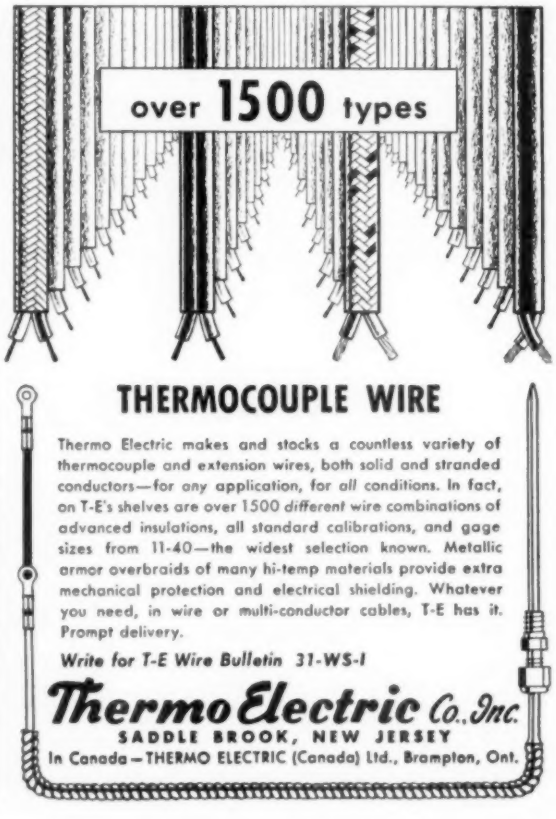
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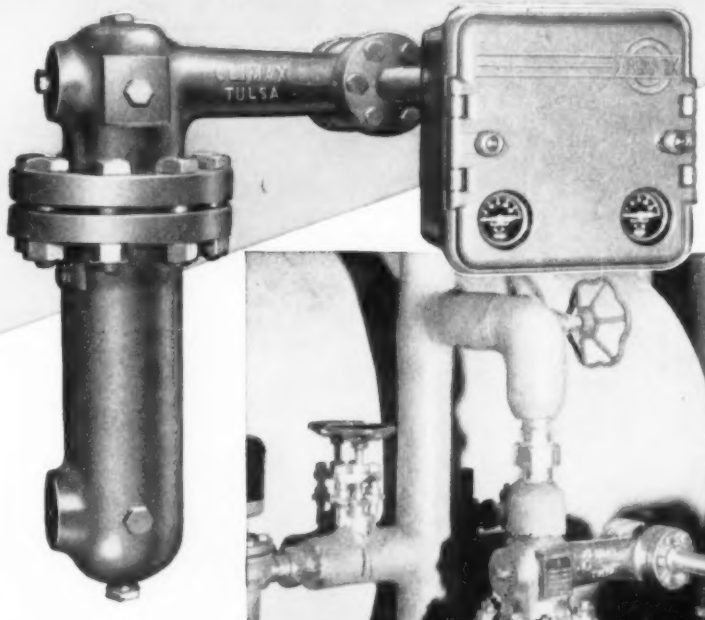
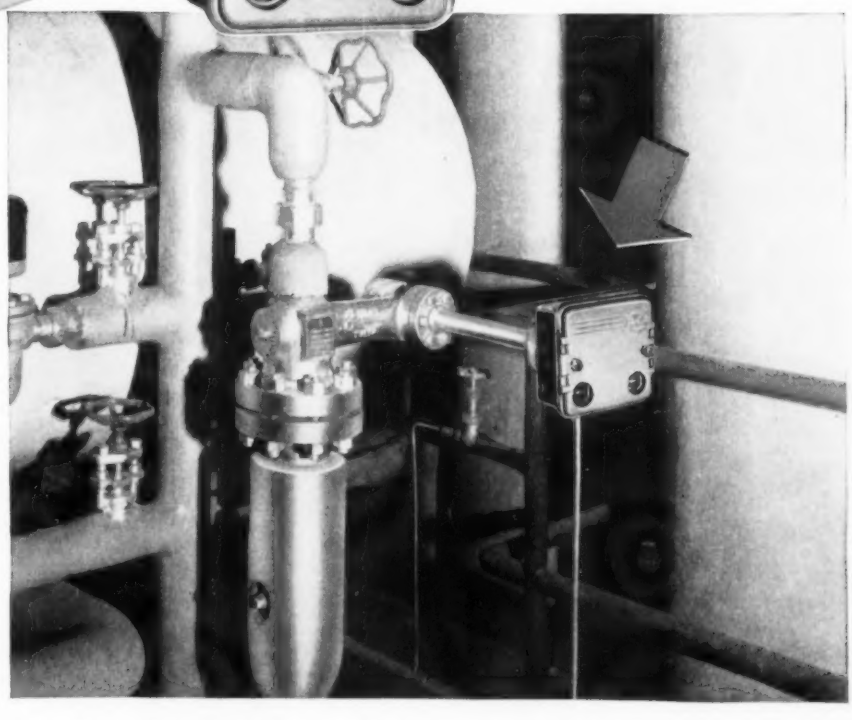


BS&B Type 71-06, Series 2!



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For Complete Information On The BS&B Type 71-06, Series 2, Or Other BS&B Liquid Level Controllers, Contact Your BS&B Sales Engineer — or Write To . . .

BLACK, SIVALLS & BRYSON, INC.
Controls Division, Dept. 4-D8
7500 East 12th Street
Kansas City 26, Missouri

Patents (continued)

FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT NO.
Lubricant	castor & mineral oil	organic ester additives	C. C. Wakefield & Co. Ltd.	2,796,400
	isoparaffinic lube oil	Cd salt & thiocarbonic acid	Shell Development Co.	2,794,781
	lube oil	rust preventative	Standard Oil Co. (Ind.)	2,796,407
	lube oil	various corrosion inhibitors	California Research Corp.	2,795,547-553
	mineral lube base	aliphatic & aromatic nitro cmpds.	Chemische Werke Huls A.G.	2,793,999
	mineral lube oil	ext. press. & anti-corrosion props.	The Texas Company	2,796,404
	mineral lube oil	pour-point depressant	Shell Development Co.	2,796,406
	mineral lube oil	rhodanine anti-corrosion add.	The Texas Company	2,796,403
	mineral oil	anti-rust emulsion additives	Monsanto Chemical Co.	2,794,782
Monosulfonates	benzene series	alkanolamine group	Shell Development Co.	2,796,429
Reduction	fuel knock	tri-hydrocarbon sub. methanes	Ethyl Corp.	2,794,713-723
Removal	fingerprints	corrosion-inhibiting properties	Standard Oil Co. (Ind.)	2,796,408
Repelling	insects	polycyclic aldehydes & alcohols	Phillips Petroleum Co.	2,795,526
Residual fuel oil	residuum	phosphorous-containing cmpd.	Esso Research & Engrg. Co.	2,793,945
Set retarding	cements	H_2O sol. salt of sulfobenzyl-cellulose	Phillips Petroleum Co.	2,795,507-8
Stabilization	gasoline	oxidation inhibitor	Universal Oil Products Co.	2,793,944
Synthetic lubricant	hydrocarbon radicals	ester linkages	Esso Research & Engrg. Co.	2,796,423
Synthetic lube	long-chain radicals	molecular wgt. between 20 & 130	Esso Research & Engrg. Co.	2,796,401
Wax composition	paraffin wax	ester antifoaming composition	Continental Oil Co.	2,796,355

Equipment

Contacting	fluids	cylinder with perf. partition	Universal Oil Products Co.	2,795,489
	lift gas	granular solid particles	Socony Mobil Oil Co., Inc.	2,793,915
	liquid phases	countercurrent tray column	Esso Research & Engrg. Co.	2,794,711
Control	liquid level	fractionating column	California Research Corp.	2,795,536
Gaging	liquids under pressure	fluid conducting sensing tube	G. W. McLellan	2,795,954
Pumping	viscous fluids	high pressure system	Du Pont	2,795,195
Removal	granular solids	self-sealing outlet on reactor	Socony Mobil Oil Co., Inc.	2,794,772
Separation	slurries	centrifuge	Phillips Petroleum Co.	2,795,635
Testing	liquid metering pumps	master pump	Imperial Chemical Industries Ltd.	2,795,950

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ANY PRESSURE — ANY TEMPERATURE

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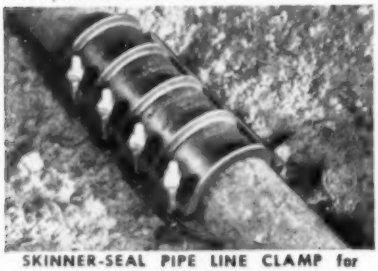
for pinhole or corrosion leaks.



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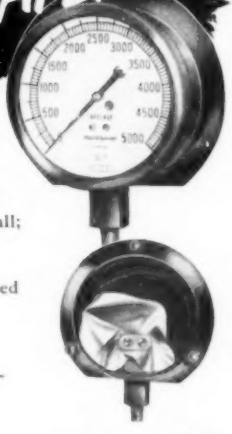

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Test Proves Safety
Explosive force of cartridge merely opens out safety-release back. Back is firmly attached to case and cannot be dislodged during a pressure blow-out.

MARSH GAUGES

If it's a question of corrosion . . .

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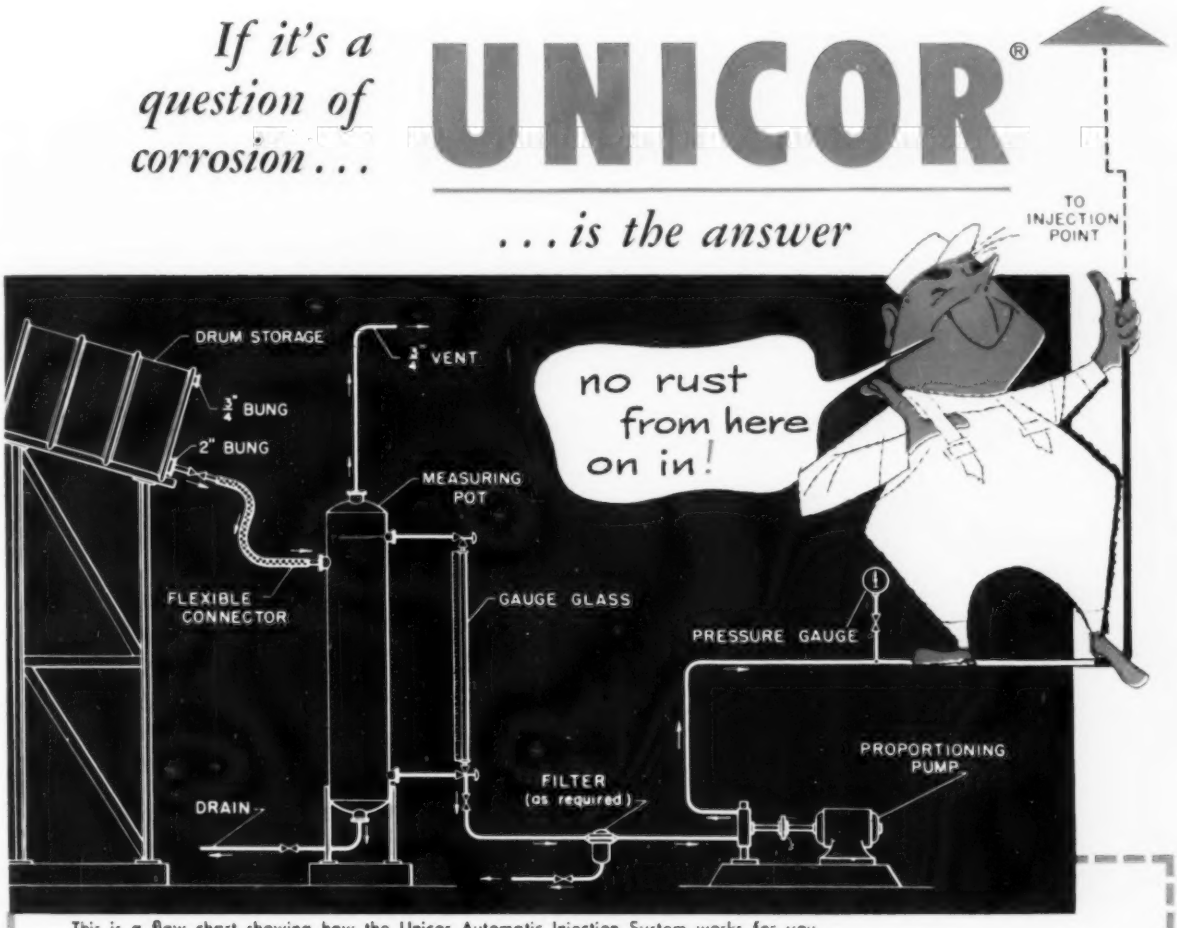
. . . is the answer



This is a flow chart showing how the Unicor Automatic Injection System works for you.

Question: *How can we eliminate serious filter fouling in blending tank caused by formation of highly peptized iron rust during processing?*

Answer: UOP's Unicor corrosion inhibitor solved this problem for a large southern refiner not long ago. Before Unicor application, a yard-square panel of the tank interior was sandblasted down to bare metal to test Unicor's effectiveness. After several months of injection in the rundown line, this test panel was completely free of corrosion, the remainder of tank interior was free of filter-fouling rust.

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Answer: About $0.001 or a tenth of a cent per bbl. of product in normal application.

Let us send you samples of

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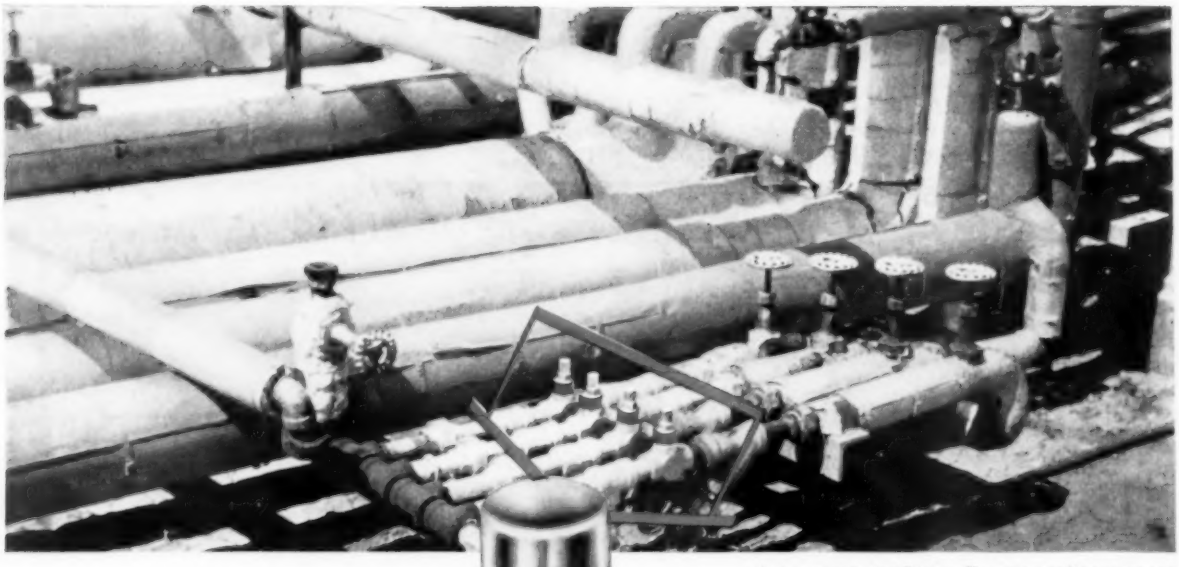
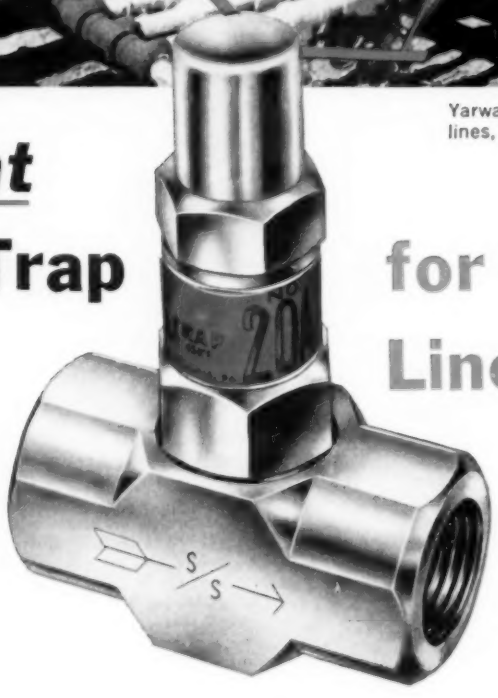
(To obtain more data on advertised products see page 126)



Yarway Impulse Steam Traps on refinery tracer lines, discharging into a common header.

the *right* Steam Trap for Tracer Line Service



The Yarway ½" No. 20-A Impulse Steam Trap is known throughout the processing industries as the right trap for steam tracer lines. The No. 20-A is especially designed for efficient handling of tracers, steam main drips, and other *light condensate loads.*

Small size, light weight, stainless steel construction, only one moving part, maintenance of high even temperatures, and resistance to freeze-ups are distinctive Yarway Impulse Trap features. Well over a million Yarways proved by performance.

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The Impulse that revolutionized steam trapping 20 years ago.

By STUART D. BOYNTON, Assistant Editor

Details of Petroleum Conference

SESSIONS on refinery materials will highlight the Petroleum Mechanical Conference of the American Society of Mechanical Engineers this fall. The meeting will be at the Mayo Hotel, Tulsa, from September 23 to 25. Papers to be given in the refining sessions are as follows:

Materials of construction

"Report on Strength of Welded Joints in Carbon Steel at Elevated Temperatures," by the special task group, petroleum and chemical panel, Joint ASTM-ASME Research Committee, and presented by W. B. Hoyt, M. W. Kellogg Co.

"Plastic Pipe in the Petroleum Industry," by George C. Anderson, U.S. Steel Co.

Gasket and reformer tubes

"Packing and Gaskets," by R. H. Koch, Du Pont Co.

"Furnace Tube Alloys for Hydrocarbon Pyrolysis and Steam Methane Reforming," E. N. Skinner and B. B. Morton, International Nickel Co.

Panel on the ASME Pressure Vessel Code

Panelists:

G. S. Chadwick, Jr., Union Carbide Chemicals Co.

E. C. Korten, Hartford Steam Boiler Inspection & Insurance Co.

J. J. Murphy, M. W. Kellogg Co.

Walter Samans, Taylor Forge & Pipe Works.

F. F. G. Williams, Taylor Forge & Pipe Works.

Panel on welding design and practices

Panelists:

Leon C. Bibber, U.S. Steel Co.

A. P. Naradudin, Standard Oil Co. of California.

N. Rozek, A. O. Smith Corp.

D. V. Wilcox, Reynolds Aluminum Co.

W. H. Skewis, Midwest Piping Co.

J. Bland, Standard Oil Co. (Ind.).

J. P. Baughman, Dow Chemical Co.

Inert gas

"Eight Years' Experience with Inert Gas Injection Equipment at Elk Basin," by G. O. Bates, Pan-American Petroleum Corp.

Safety Controls and Procedures for Inert Gas Machines," by C. H. Evans, Du Pont Co.

Engineering scheduling and development

"Scheduling Engineering Design—A Vital Force in Refinery Operations," by H. T. Campbell, Humble Oil & Refining Co.

"Evaluation and Development of Technical People," by Randall Meyer, Esso Standard Oil Co.

Piping fabrication

"Requirements for Fabrication of Pressure Piping as Related to Service," by C. R. Soderberg, Jr., M. W. Kellogg Co.

Mechanical research

"Mechanical Seals for Non-Lubricating Hydrocarbons," by A. L. Decker, Ethyl Corp.

"Economic Aspects of Combination Gas Turbine Applications in the Refining Industry," C. R. Apitz, Clark Bros.

"Overstrain and Bursting Strength of Thick Walled Cylinders," by S. M. Jorgenson, Foster Wheeler Corp.

Stack and flange design

"Anchor Flange Design," by A. J. Del Buono, Taylor Forge and Pipe Works, and E. O. Waters, Yale University.

"Analysis and Design of Skirt Supports for Pressure Vessels," by N. A. Weil, M. W. Kellogg Co.

Refining papers slated for AIEE petroleum conference

H. M. Stewart, of Humble Oil & Refining Co., will be chairman of the two refining sessions at the Electrical Conference of the Petroleum Industry of the American Institute of Electrical Engineers. Meeting is scheduled for Sept. 9 to 11 at Philadelphia's

Oil Man's Calendar

Boldface items reviewed in this issue

AUGUST

26-28 Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.

26-30 American Institute of Electrical Engineers, Pacific General meeting, Yakima, Wash.

28-30 Instrument Society of America, first symposium on gas chromatography, Kellogg Center for Continuing Education, East Lansing, Mich.

SEPTEMBER

8-13 American Chemical Society, national meeting, New York City

9-11 Electrical Conference of the Petroleum Industry, American Institute of Electrical Engineers, Sheraton Hotel, Philadelphia

9-13 Instrument Automation Conference and Exhibit, Instrument Society of America, Auditorium, Cleveland

11-13 National Petroleum Assn., annual, Traymore Hotel, Atlantic City

15-18 American Institute of Chemical Engineers, national meeting, Lord Baltimore Hotel, Baltimore, Md.

22-24 Independent Oil Compounders Assn., annual, Carter Hotel, Cleveland

23-25 Petroleum Mechanical Conference, ASME, Tulsa, Okla.

23-25 American Society of Mechanical Engineers, fall meeting, Statler Hotel, Hartford, Conn.

26-27 Western Petroleum Refiners Assn., Rocky Mountain regional technical-industrial relations meeting, Henning Hotel, Casper, Wyo.

OCTOBER

1-4 National Assn. of Corrosion Engineers, North Central Region meeting, Sherman Hotel, Chicago

1-4 National Assn. of Corrosion Engineers, South Central Region, Oklahoma City, Oklahoma

6-10 American Society for Testing Materials, Committee D-2, Sheraton Park Hotel, Washington, D.C.

7-9 Lubrication Conference, ASME and the American Society of Lubrication Engineers, Royal York Hotel, Toronto

7-9 American Gas Assn., annual, Kiel Auditorium, St. Louis, Mo.

7-11 American Institute of Electrical Engineers, fall general meeting, Morrison Hotel, Chicago

9-11 Symposium on High Vacuum Technology, Committee on Vacuum Techniques, Hotel Somerset, Boston, Mass.

10-11 California National Gasoline Assn., annual, Huntington-Sheraton Hotel, Pasadena, Calif.

21-23 American Society of Mechanical Engineers, power meeting, Americus Hotel, Allentown, Pa.

22 Association of Consulting Chemists and Chemical Engineers, annual, Belmont Plaza Hotel, New York City

22 American Institute of Chemical Engineers, New York Section, Hotel Statler, New York

22-24 Western Regional Conference, National Assn. of Corrosion Engineers, San Diego, Calif.

23-25 Permian Basin Corrosion Tour, NACE, Odessa, Texas

24-25 Western Petroleum Refiners Assn., regional technical-industrial relations meeting, Garrett Hotel, El Dorado, Ark.

25 Natural Gasoline Assn. of America Southern Region meeting, Washington-Youree and Capt. Shreve Hotels, Shreveport, La.

28-29 National Lubricating Grease Institute, annual, Edgewater Beach Hotel, Chicago

NOVEMBER

4-8 National Metal Congress & Exposition and 2nd World Metallurgical Congress, sponsored by the American Society for Metals and others, International Amphitheater, Chicago

6-8 Society of Automotive Engineers, fuels and lubes meeting, Hotel Statler, Cleveland

11-14 American Petroleum Institute, annual, Conrad Hilton Hotel, Chicago

12-14 National Assn. of Corrosion Engineers, North Central Region, Penn-Sheraton Hotel, Pittsburgh

22 Natural Gasoline Assn. of America, Panhandle Plains Regional, Herring Hotel, Amarillo, Texas

DECEMBER

1-6 American Society of Mechanical Engineers, annual, Statler, New York

8-11 American Institute of Chemical Engineers, annual, Hilton Hotel, Chicago

JANUARY

2-3 American Chemical Society, Christmas Symposium, Division of Industrial and Engineering Chemistry, Case Institute, Cleveland

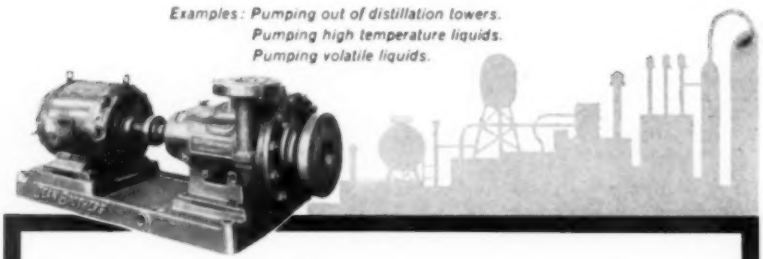
HOW! PUMP USERS—

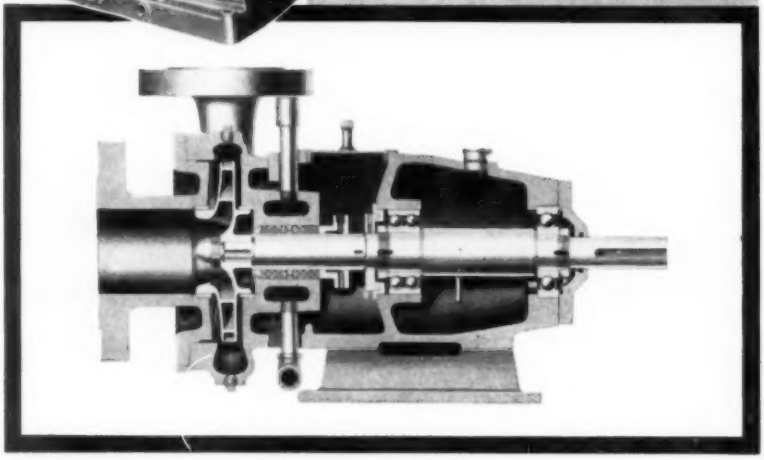
SOLVE YOUR NPSH* TROUBLES WITH DEAN BROTHERS STANDARD CENTRIFUGAL PUMPS

These standard, horizontal, centrifugal pumps are designed to operate with low **Net Positive Suction Heads*. This keeps equipment and operating costs down in process industries . . .

- where the pump suction is under low absolute pressure,
- where liquid pumped is close to its vapor pressure due to temperature.

Examples: Pumping out of distillation towers.
Pumping high temperature liquids.
Pumping volatile liquids.





The low *NPSH* requirements of Dean Brothers standard centrifugal pumps result from the design of the impeller for low inlet losses—without danger of cavitation and the resultant loss of head and capacity.

Dean Brothers offers a series of charts showing the relationship between pump rotative speed, pump capacity and NPSH. Process designers find them valuable in sizing and locating vessels and pumps on flow sheets as well as for the trouble-free application of pumps. They're **free.** Write for Curve No. S-1 A.

DEAN BROTHERS PUMPS INC.
EST. 1869
323 West 10th St., Indianapolis 7, Ind.

new Sheraton Hotel. The papers to be read at the sessions are as follows:

Monday, Sept. 9

"Electrical Engineers in the Petroleum Industry," by J. M. Crothers, Catalytic Construction Co.

"The Industrial User Analyzes the Power Service," by L. W. Swanson and C. W. Boyce, C. F. Braun & Co.

"The Electrical Features of the Tidewater Delaware City Refinery," by G. E. Harney and R. B. Heckert, C. F. Braun & Co.

Wednesday, Sept. 11

"Development of a 75 MVA Refinery Power System Involving Local Generation and Utility Supply," by J. F. Peterson, Bechtel Corp., and John Lindquist, Standard Oil Co. of California.

"Economics and Reliability of Electric Motors Vs. Steam Turbines in Oil Refineries," by Lee B. Eddy, Universal Oil Products Co.

"Basic Lighting for Petroleum Refining Process Units," by William D. Mascaro, Atlantic Refining Co.

"Economic Justification for Corrosion-Resistant Electrical Materials," by J. M. Bryan, Humble Oil and Refining Co.

NGAA cancels meeting at Oklahoma City, Sept. 27

The regional meeting of the Natural Gasoline Association of America scheduled for Oklahoma City on Sept. 27 has been cancelled. The change was necessary because of a meeting in Billings, Mont., only two days before. The Oklahoma City meeting will be held on Jan. 31, 1958.

Early details of IOCA 10th annual

The Independent Oil Compounders Association will hold its 10th annual meeting at the Carter Hotel in Cleveland, Sept. 22-24. The program, in its early form, is as follows:

An anniversary address will be given by L. F. Paape, first president of the group and president and board chairman of Filmite Oil Corp. and W. J. Cramer Co.

"Equipment for Cleaning and Reconditioning Used Steel Drums," is the title of a paper by Allen A. Armitage, chief engineer of the L. M. Gilbert Co.

The next paper, as yet untitled, will be given by Carl T. Doman, national service manager, Parts and Service Operations, of Ford Motor Co.

Another speaker will be V. A. Gates, senior engineer, Products Application Department, Shell Oil Co. His topic is "Facts and Figures From a Used-Motor-Oil Survey."

The final paper will be "The Development and Application of a Broad Performance Range Gear Lubricant Additive," by R. K. Williams, W. C. Brandon, and J. W. Schutte, of Lubrizol Corp.

(To obtain more data on advertised products see page 126)

Refinery men depend on Davison for...

M-S® CRACKING CATALYSTS
Silica-Alumina (13% and 25%)
Silica-Magnesia (experimental)

REFORMING CATALYSTS
Catforming Catalyst—Silica-Alumina-Platinum
Powerforming Catalyst—Alumina-Platinum

DEHYDROGENATION CATALYST
Chromia-Alumina

POLYOLEFIN CATALYST
Chromia-Silica-Alumina

DEHYDRATING AGENT
Silica Gel

ANTIOXIDANTS
Dav-Ad 101 (alkylated phenol)
Dav-Ad 102 (alkylated phenol in toluene)

Complete laboratory facilities and technical assistance

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Division of W. R. Grace & Co.
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SALES OFFICES: Chicago, Ill.; Houston, Tex.; New York, N. Y.; Baltimore, Md.; San Francisco, Calif.; Tulsa, Okla.
In Canada: Davison Chemical Company Ltd., Toronto.

(To obtain more data on advertised products see page 126)

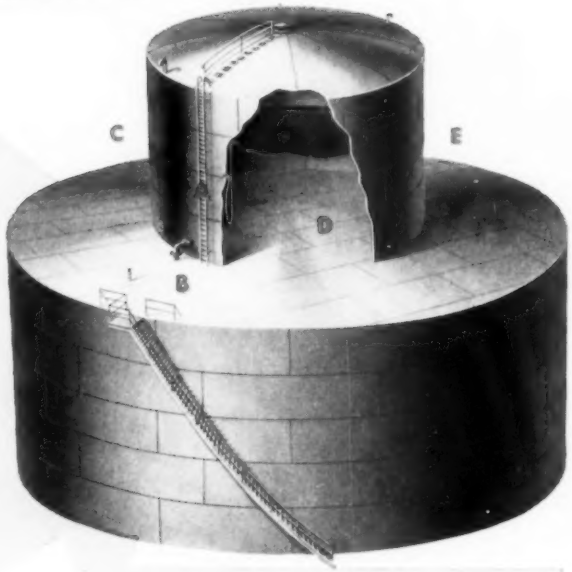
THE HAMMOND
DIALIFT

the only membrane type conservation tank

...with full-rated vapor and product capacity at all times

...with a membrane that cannot come in contact with product

...with vapor space that can be isolated for inspection and maintenance without taking tank out of service.



Principle of the Hammond Dialift

A—DIALIFT DIAPHRAGM rises and falls to accommodate expanding and contracting vapor.

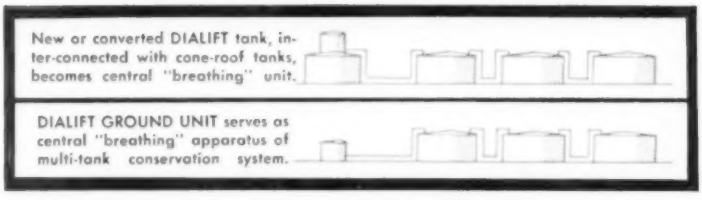
B—Vapor passes to and from tank and DIALIFT through simple elbow connection.

C—DIALIFT and tank have full-rated capacity.

D—Membrane can't come in contact with product.

E—DIALIFT can be isolated for maintenance and inspection, product tank stays in service.

The most efficient and economical vapor conservation system for new or old tanks.


New or converted DIALIFT tank, inter-connected with cone-roof tanks, becomes central "breathing" unit.
DIALIFT GROUND UNIT serves as central "breathing" apparatus of multi-tank conservation system.

THE HAMMOND DIALIFT consists of a gas-tight Vulcalock membrane attached to the inside periphery of a cylindrical metal housing to become a "breathing" apparatus to accommodate the expanding and contracting vapor as developed in product storage tanks. The DIALIFT can be used as a single conservation unit by being attached to the roof of a product storage tank or as a central "breathing" system by being manifolded to a number of product storage tanks. There are two forms of installation:—Ground type manifolded to a number of tanks to form a conservation system and integrated type whereby the DIALIFT is attached to the roof of a tank for vapor conservation for one or a number of tanks. The DIALIFT is completely isolated from the product storage tank. Vapor passes between the tank and DIALIFT through a vaporline connection. It is easy to convert old cone roof tanks to efficient vapor-saving DIALIFT installations by attaching a DIALIFT housing with membrane to the roof of the old tank and connecting the vaporline between the tank and DIALIFT.

THE HAMMOND DIALIFT ELIMINATES BREATHING LOSS AND REDUCES FILLING LOSS

Write for dialift catalog 55DL

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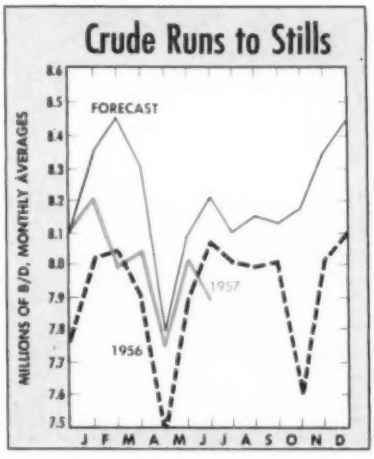
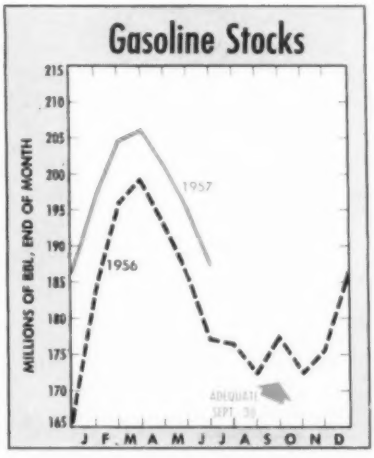
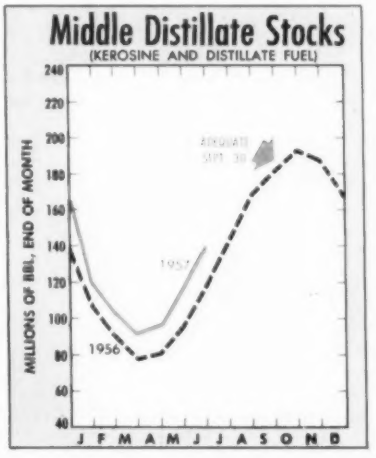
By VIRGIL B. GUTHRIE, Consulting Editor






Middle Distillate Stocks
(KEROSINE AND DISTILLATE FUEL)
MILLIONS OF BBL, END OF MONTH
ADEQUATE SEPT. 30
1957
1956
J F M A M J J A S O N D

Summer demand disappoints

OUTLOOK: For gasoline demand to bounce back in the late summer and fall.

A SMALLER increase in demand than had been anticipated for the third quarter has kept refiners from recovering from their stepped-up operations last spring, when they were meeting the emergency demands in Western Europe caused by the Suez crisis. Restraint in scope of operations will be required if we are to avoid going into the winter with a surplus of both light and heavy fuel oil inventories.

Several factors combined to hold down domestic gasoline demand in the late spring and early summer. The slackening in some industries was one factor. Storms and tornadoes in the west and southwest held down highway travel and cut back farming operations. Indicated gasoline demand in June was 1.3% less than in June, 1956. For the first six months, demand has been about 2% lower than for the 1956 period.

Even with these lower requirements, refiners have been cutting down their gasoline inventories at about twice the rate of last year. U. S. gasoline stocks May 31 were 195,285,000 bbl, about 10,000,000 bbl higher than May 31, 1956. From May 31 to July 12 these inventories were cut 13,312,000 bbl, while in the same weeks in 1956 they were reduced 6,504,000 bbl. July 12 inventories of 181,973,000 bbl were only 3,600,000 bbl larger than on July 13, 1956.

Refiners started June with distillate fuel oil stocks of 96,881,000 bbl, 19,482,000 bbl (25.2%) larger than in 1956. By July 12 they had built up to 125,563,000 bbl, compared with 104,521,000 bbl on July 13, 1956. If fourth quarter weather is mild and heating oil demand light, distillate inventories will be heavy to start the winter, except as there is restraint in current refinery operations.

Crude runs to stills in the six weeks June 1 through July 12 were 7,898,000 b/d avg., 1.7% less than in the same period in 1956, due in part to the strike of refinery workers which closed down 270,000 b/d charge capacity over part of this period.

PRODUCT AND CRUDE PRICES

(Products—¢ gal, weighted average prices in principal refinery markets
Crudes—$ bbl, principal fields
Source—Platt's Oilgram Price Service)

	June 1957	May 1957	June 1956
Gasoline (regular)	12.60	12.72	12.05
Distillate Fuel Oil	10.04	10.27	9.34
Kerosine	11.50	11.75	10.95
Residual	6.31	6.42	5.20
Above 4 Products	10.27	10.41	9.53
Lube Oils	24.17	24.17	22.63
Crude	3.19	3.18	2.84

REFINERY YIELDS

% on Crude Run to Stills

	June 1957	May 1957	June 1956
Gasoline	44.1	43.8	44.3
Kerosine	3.3	3.6	3.6
Distillate	22.1	22.8	22.0
Residual	14.3	14.1	13.8

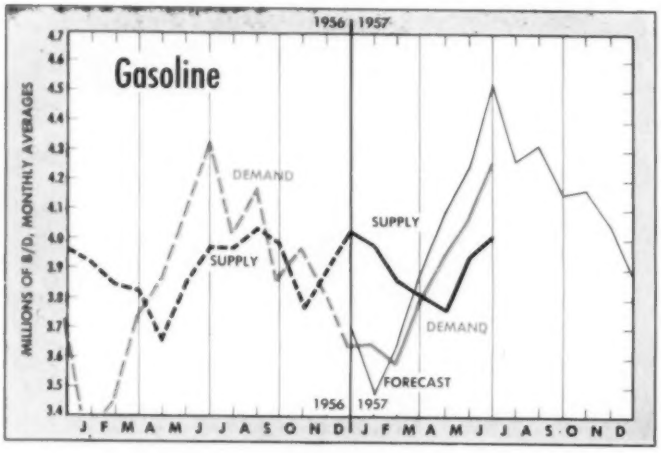
JUNE KEY STATISTICS

(Figures given in terms of millions of b/d, monthly averages, except stocks, which are in millions of bbl at end of month)

	June 1957	May 1957	June 1956
CRUDE OIL			
U. S. Production	7.244	7.462	7.100
Imports	1.195	1.003	.987
U. S. Stocks	277.532	268.601	274.491
Runs to Stills	7.891	8.015	8.071
GASOLINE			
Refinery Output	3.909	3.835	3.880
Refinery Demand	4.269	4.079	4.327
Primary Stocks	187.778	195.285	177.076
MIDDLE DISTILLATES			
Refinery Output	2.008	2.113	2.045
Refinery Demand	1.273	1.365	1.333
Primary Stocks	144.632	121.901	119.869
RESIDUALS			
Refinery Output	1.132	1.134	1.098
Imports & Other	.484	.425	.396
Total Supply	1.616	1.559	1.494
Refinery Demand	1.448	1.468	1.412
Primary Stocks	45.115	40.067	39.073

SOURCE OF DATA (except prices): May, June and July, API weekly reports; earlier months, Bureau of Mines

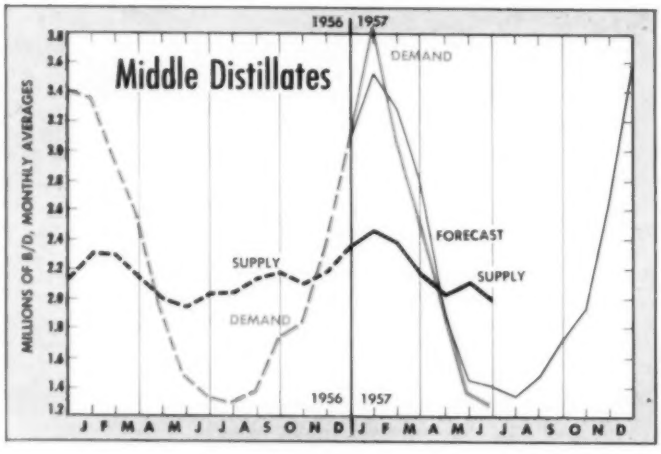
June gasoline demand lower than a year ago


Gasoline
1956 | 1957
MILLIONS OF B/D, MONTHLY AVERAGES
DEMAND
SUPPLY
SUPPLY
DEMAND
FORECAST
1956 1957
J F M A M J J A S O N D J F M A M J J A S O N D

MOTOR FUEL

	From Crude		From Nat. Gas		Total
SUPPLY (Millions of b/d)					
June '57	3.576		.443		4.019
June '56	3.537		.439		3.976
Change	+ .039	+	.004	+	.043
% Change	+ 1.1	+	0.9	+	1.1
DEMAND (including Exports) (Millions of b/d)					
June '57					4.269
June '56					4.327
Change				—	.058
% Change				—	1.3
TOTAL SUPPLY (Millions of bbl)					
6 Mos. '57	623.070		83.677		706.747
6 Mos. '56	621.731		78.727		700.458
Change	+ 1.339	+	4.950	+	6.289
% Change	+ 0.2	+	6.3	+	0.9
TOTAL DEMAND (including Exports) (Millions of bbl)					
6 Mos. '57					704.592
6 Mos. '56					691.504
Change				+	13.088
% Change				+	1.9

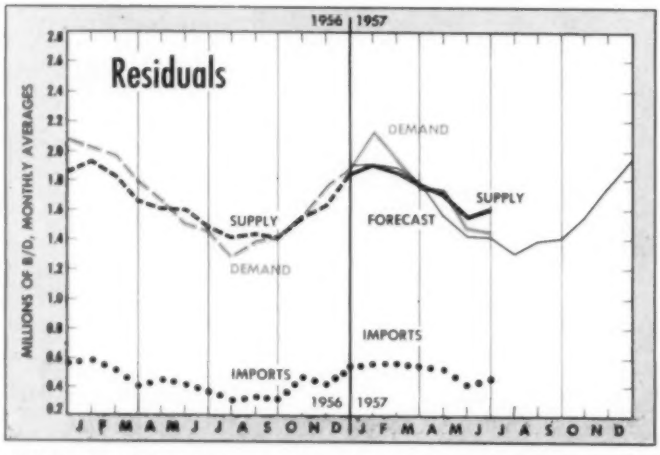
Distillate fuel-oil demand drops below the 1956 low


Middle Distillates
1956 | 1957
MILLIONS OF B/D, MONTHLY AVERAGES
DEMAND
FORECAST
SUPPLY
SUPPLY
DEMAND
1956 1957
J F M A M J J A S O N D J F M A M J J A S O N D

MIDDLE DISTILLATES

	Kerosine		Dist. Fuel Oil		Total
PRODUCTION (Millions of b/d)					
June '57	.263		1.746		2.008
June '56	.290		1.755		2.045
Change	— .027	—	.010	—	.037
% Change	— 9.3	—	0.6	—	1.8
DEMAND (including Exports) (Millions of b/d)					
June '57	.153		1.120		1.273
June '56	.152		1.181		1.333
Change	+ .001	—	.061	—	.060
% Change	+ 0.7	—	5.2	—	4.5
TOTAL PRODUCTION (Millions of bbl)					
6 Mos. '57	56,810		342.264		399.074
6 Mos. '56	60.435		326.976		387.411
Change	— 3.625	+	15.288	+	11.663
% Change	— 6.0	+	4.7	+	3.0
TOTAL DEMAND (including Exports) (Millions of bbl)					
6 Mos. '57	59.872		363.420		423.292
6 Mos. '56	62.105		348.319		410.424
Change	— 2.233	+	15.101	+	12.868
% Change	— 3.6	+	4.3	+	3.1

Residual supply, demand trends seasonally lower



RESIDUAL FUELS

	Refinery Output		Imports & Other		Total
SUPPLY (Millions of b/d)					
June '57	1.132		.484		1.616
June '56	1.098		.396		1.494
Change	+ .034	+	.088	+	.122
% Change	+ 3.1	+	22.2	+	8.2
DEMAND (including Exports) (Millions of b/d)					
June '57					1.448
June '56					1.412
Change				+	.036
% Change				+	2.5
TOTAL SUPPLY (Millions of bbl)					
6 Mos. '57	217.265		97.817		315.082
6 Mos. '56	219.035		89.492		308.527
Change	— 1.770	+	8.325	+	6.555
% Change	— 0.8	+	9.3	+	2.1
TOTAL DEMAND (including Exports) (Millions of bbl)					
6 Mos. '57					313.983
6 Mos. '56					308.628
Change				+	5.355
% Change				+	1.7

SOURCE OF DATA: May, June and July, API weekly reports; earlier months, Bureau of Mines (1956 figures for 366 days)

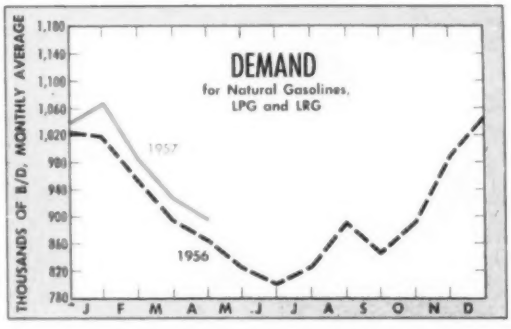
RUNS TO STILLS AND DISTRIBUTION OF PRIMARY STOCKS BY U.S. REFINERY DISTRICTS

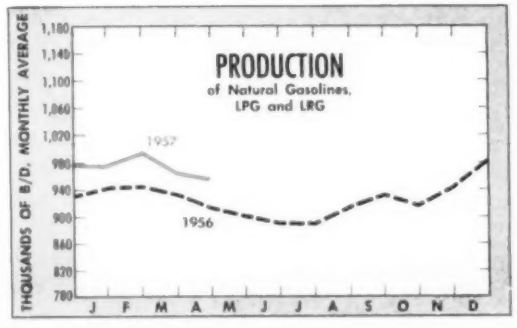
(Primary stocks include those at refineries, at large terminals and in pipelines; all data based on API reports)

District	RUNS TO STILLS (Millions of b/d average for week ending on date shown) July 12 1957	July 13 1956	Change	% Change	GASOLINE STOCKS (Millions of bbl on date shown) July 12 1957	July 13 1956	Change	% Change	RESIDUAL STOCKS (Millions of bbl on date shown) July 12 1957	July 13 1956	Change	% Change
East Coast	1.275	1.174	+ .101	+ 8.6	41.882	40.464	+ 1.418	+ 3.5	12.166	10.982	+ 1.184	+10.8
Gulf Coast	2.601	2.631	— .030	— 1.1	34.601	34.435	+ .166	+ 0.5	7.758	7.780	— .022	— 0.3
Total Coastal	3.876	3.805	+ .071	+ 1.8	76.493	74.899	+ 1.584	+ 2.1	19.924	18.762	+ 1.162	+ 6.2
Appalachian	.155	.208	— .053	—25.5	7.033	7.309	— .276	— 3.8	.736	.710	+ .026	+ 3.7
Ind.-Ill.-Ky.	1.332	1.431	— .099	— 6.9	35.497	35.323	+ .164	+ 0.5	6.360	4.806	+ 1.554	+32.3
Okla.-Kans.-Mo.	.799	.777	+ .022	+ 2.8	18.261	19.064	— .803	— 4.2	1.227	1.436	— .209	—14.6
Other Inland	.680	.675	+ .005	+ 0.7	18.562	18.208	+ .354	+ 1.9	3.138	2.555	+ .583	+22.8
Total Inland	2.966	3.091	— .125	— 4.0	79.343	79.904	— .561	— 0.7	11.461	9.507	+ 1.954	+20.6
Total East of Calif.	6.842	6.896	— .054	— 0.8	155.826	154.803	+ 1.023	+ 0.7	31.385	28.269	+ 3.116	+11.0
Calif.	1.130	1.132	— .002	— 0.2	26.147	23.563	+ 2.584	+11.0	15.635	12.657	+ 2.978	+23.5
Total U. S.	7.972	8.028	— .056	— .07	181.973	178.366	+ 3.607	+ 2.0	47.020	40.926	+ 6.094	+14.9

District	DISTILLATE FUEL OIL STOCKS (Millions of bbl on date shown) July 12 1957	July 13 1956	Change	% Change	KEROSINE STOCKS (Millions of bbl on date shown) July 12 1957	July 13 1956	Change	% Change	TOTAL MIDDLE DISTILLATE STOCKS (Millions of bbl on date shown) July 12 1957	July 13 1956	Change	% Change
East Coast	43.608	32.262	+11.346	+35.2	11.369	10.607	+ .762	+ 7.2	54.977	42.869	+12.108	+28.2
Gulf Coast	21.435	21.103	+ .332	+ 1.6	6.777	6.160	+ .617	+10.0	28.212	27.263	+ .949	+ 3.5
Total Coastal	65.043	53.365	+11.678	+21.9	18.146	16.767	+ 1.379	+ 8.2	83.199	70.132	+13.057	+18.6
Appalachian	3.234	2.880	+ .354	+12.3	1.066	1.204	— .138	—11.3	4.300	4.084	+ .216	+ 5.3
Ind.-Ill.-Ky.	21.526	17.943	+ 3.583	+20.0	6.187	5.736	+ .451	+ 7.9	27.713	23.679	+ 4.034	+17.0
Okla.-Kans.-Mo.	14.506	13.074	+ 1.432	+11.0	2.088	1.974	+ .114	+ 5.8	16.594	15.048	+ 1.546	+10.3
Other Inland	7.542	6.463	+ 1.079	+16.7	1.381	1.348	+ .033	+ 2.5	8.923	7.811	+ 1.112	+14.2
Total Inland	46.808	40.360	+ 6.448	+16.0	10.722	10.262	+ .460	+ 4.5	57.530	50.622	+ 6.908	+13.6
Total East of Calif.	111.851	93.725	+18.126	+19.4	28.868	27.029	+ 1.839	+ 6.8	140.719	120.754	+19.965	+16.5
Calif.	13.712	10.796	+ 2.916	+27.0	.385	.386	— .001	— 0.3	14.097	11.182	+ 2.915	+26.1
Total U. S.	125.563	104.521	+21.042	+20.1	29.253	27.415	+ 1.838	+ 6.7	154.816	131.936	+22.880	+17.3

Natural gas and refinery gas liquids





SUPPLY AND DEMAND STATISTICS
(Bureau of Mines Data)

	Apr. 1957	Mar. 1957	Apr. 1956
CURRENT PRODUCTION (1000 b/d monthly average)			
At Natural Gasoline and Cycling Plants			
Liquefied Petroleum Gas	432	436	396
Natural Gasoline and Isopentane	303	299	289
Condensate	19	20	22
Finished Gasoline, Naphtha and other	67	69	63
Total Natural Gasoline and Cycling Plant Production	821	824	770
Liquefied Refinery Gases	146	147	146
Total Marketable Gas Liquids	967	971	916
Lease Condensate	142	146	129
Total Natural Gas Liquids	1,109	1,117	1,045
CURRENT DEMAND (1000 b/d monthly average)			
LPG and LRG	514	539	497
Natural Gasoline, Isopentane and Other	391	397	370
Total Marketable Gas Liquids	905	936	867

	Apr. 1957	Apr. 1956
CUMULATIVE PRODUCTION (1000 bbl)		
LPG and LRG	71,699	69,377
Natural Gasoline, Isopentane and Other	45,827	45,048
Total Marketable Gas Liquids	117,526	113,425
CUMULATIVE DEMAND (1000 bbl)		
LPG and LRG	71,690	69,023
Natural Gasoline, Isopentane and Other	45,690	44,177
Total Marketable Gas Liquids	117,380	113,200

	Apr. 1957	Mar. 1957	Apr. 1956
STOCKS (1000 bbl, end of month)			
LPG and LRG	14,954	13,023	7,092
Natural Gasoline, Isopentane and Other	5,107	5,160	5,355
Total Stocks	20,061	18,183	12,447

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- Removal of Oily Condensates.
- Boiler Feed Water Supplies.
- Filtration of Spent Doctor and Process Wash Waters.
- Filtration of Water for Repressure Pumping.

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Petroleum Processing

INFORMATION OFFERED

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature and data being offered in this issue's advertisements.

Analyzer, infrared, for continuous process streams, information; Mine Safety Appliances Co. See adv't. p. 41.

Analyzer, gas and vapor-phase chromatography, bulletin 831; Burrell Corp. See adv't. p. 140.

Burners, vertical, gas and oil fired, bulletin DA-357; John Zink Co. See adv't. p. 148.

Catalysts, various types, booklet; Harshaw Chemical Co. See adv't. p. 98.

Chemicals, for additives, information; Amoco Chemicals Corp. See adv't. p. 8.

Chlorides, metallic, brochure; Stauffer Chemical Co. See adv't p. 102.

Cooling towers, aid and water cooled, bulletin; Hudson Engineering Corp. See adv't. cover 2.

Copper chloride, for Mercaptans removal, samples; Tennessee Corp. See adv't. p. 150.

Dermatitis prevention, booklet; West Chemical Products, Inc. See adv't. p. 139.

Desiccants, literature and samples; Minerals & Chemicals Corp. See adv't. p. 138.

Dryers, for instrument lines, bulletin D-27; C. M. Kemp Mfg. Co. See adv't. p. 20.

Expansion joints, hinged catalog 56; Zallea Brothers. See adv't. p. 28.

Fittings, return bends, bulletin KR-1057; W-K-M, Div. of ACF Industries. See adv't. p. 19.

Flow indicator, for high pressures, bulletin 360; Brooks Rotameter Co. See adv't. p. 112.

Furfural, for solvent extraction; Bulletin 203A; Quaker Ooats Co. See adv't. p. 108.

Heat exchangers, bulletin HE-6; Henry Vogt Machine Co. See adv't. p. 125.

Insulation, brick, refractories, brochures IN-115A & RC-28A; Johns-Manville. See adv't. p. 38.

Insulation, pipe, booklet F76-31; Union Asbestos & Rubber Co. See adv't. p. 147.

Mixers, side and top entering, 8 catalogs and data sheets; Mixing Equipment Co., Inc. See adv't. p. 42.

Motor starters, high voltage type, bulletin 8131-C; Electric Controller & Mfg. Co. Square D Co. See adv't. p. 17.

Motors, for chemical processing equipment, bulletin PB 6000-8; Elliott Co. See adv't. pp. 24-25.

Pumps, centrifugal, charts; Dean Brothers Pumps, Inc. See adv't. p. 118.

Pumps, centrifugal, bulletin 120-E; Eastern Industries, Inc. See adv't. p. 146.

Pumps, for process liquids, bulletin B-1605; Peerless Pump Div. See adv't. p. 141.

Pumps, high pressure, bulletin HP-1254; Philadelphia Pump Div. of American Meter Co. See adv't. p. 88.

Seals, mechanical, plastic, bulletin MS-1155; United States Gasket Co. See adv't. p. 86.

Steam traps, bulletin 1055; W. H. Nicholson & Co. See adv't. p. 35.

Steam traps, float and bucket, information; V. D. Anderson Co. See adv't. p. 142.

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Tanks, tank seals, vapor conservation systems, catalog 55DL; Hammond Iron Works. See adv't. p. 120.

Thermocouple wire, bulletin 31-WS-I; Thermo Electric Co., Inc. See adv't. p. 112.

Tube maintenance tools, cleaners, cutters, expanders, bulletin 59; Airetool Mfg. Co. See adv't. p. 144.

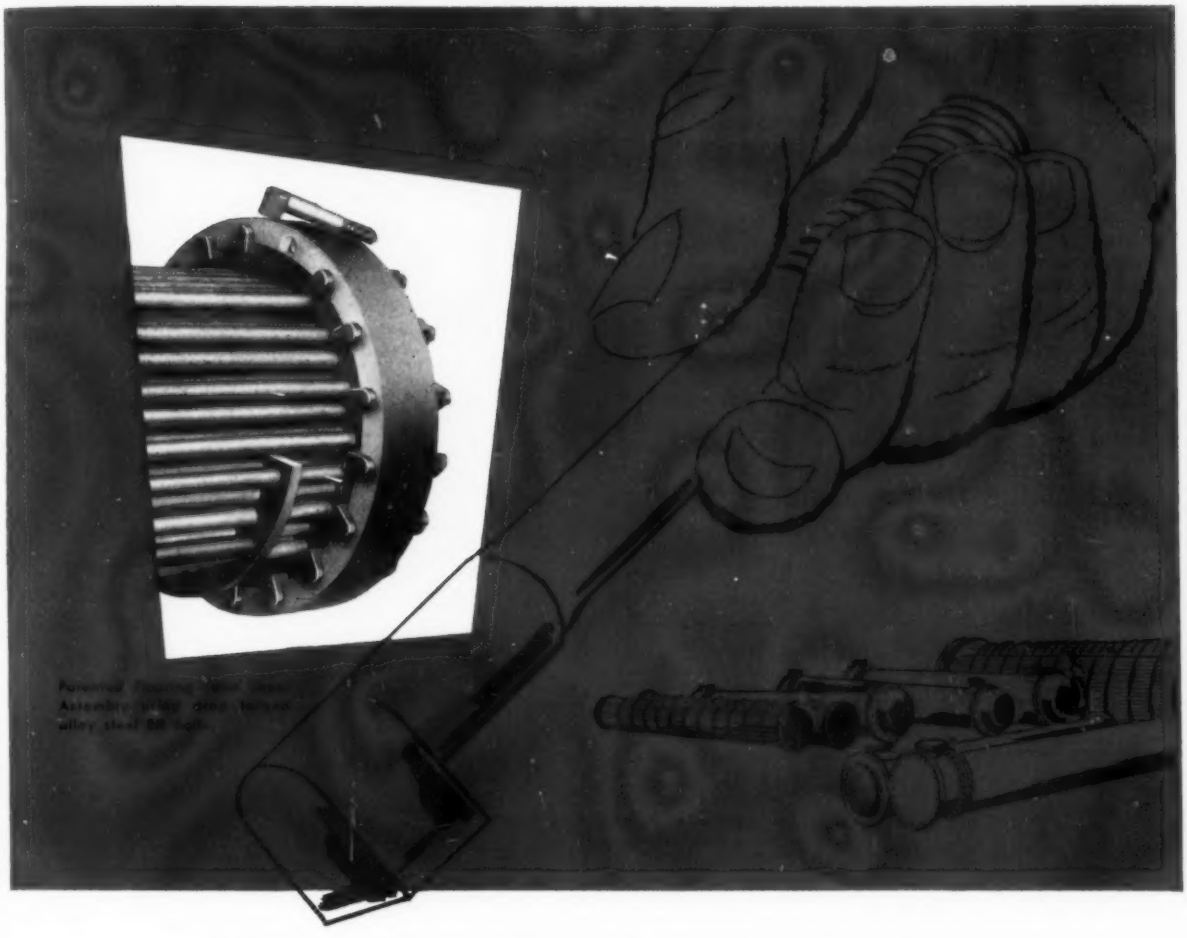
Tubing, instrument, bulletin L-6506; Samuel Moore Co. See adv't. p. 14.

Valves, pressure reducing, bulletin J-1160; Jordan Corp. See adv't. p. 84.

Valves, Safety relief, bulletin; Crosby Valve & Gage Co. See adv't. p. 90.

Valves and fittings, booklet; Crane Co. See adv't. p. 76.

Welding electrodes, folder; International Nickel Co., Inc. See adv't. p. 151.



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(To obtain more data on advertised products see page 126)

Petroleum Processing

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Walter W. Patten
Kenneth S. Willadsen
Oxford 5-5959

PHILADELPHIA 3, PA., 17th and Sansom St.
Walter R. Donahue, Rittenhouse 6-0670

ATLANTA, GA., 1301 Rhodes-Haverty Bldg.
M. H. Miller, Jackson 3-6951

CLEVELAND 15, OHIO, 1510 Hanna Bldg.
William R. Freeman, Superior 1-7000

CHICAGO 11, ILL., 520 No. Michigan Ave.
Fred R. Emerson, Mohawk 4-5800

DENVER 2, COLO., 1740 Broadway.
John W. Patten, Alpine 5-2981

HOUSTON 25, TEXAS, Prudential Bldg.
Edward E. Schirmer, Locust 1281

DALLAS 1, TEXAS, 1712 Commerce St.
Edward E. Schirmer, Riverside 7-5117

SAN FRANCISCO 4, CAL., 68 Post St.
William C. Woolston, Douglas 2-4600

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A6	B6	C6	D6	E6	F6	G6	H6	J6	K6	L6	M6	N6	O6	P6	Q6	S6	T6	U6	V6
A7	B7	C7	D7	E7	F7	G7	H7	J7	K7	L7	M7	N7	O7	P7	Q7	S7	T7	U7	V7
A8	B8	C8	D8	E8	F8	G8	H8	J8	K8	L8	M8	N8	O8	P8	Q8	S8	T8	U8	V8
A9	B9	C9	D9	E9	F9	G9	H9	J9	K9	L9	M9	N9	O9	P9	Q9	S9	T9	U9	V9

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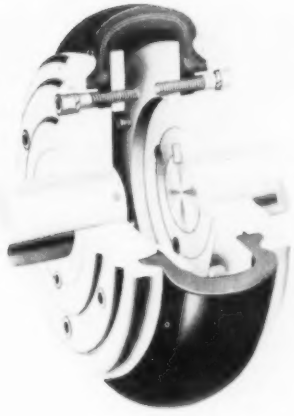
- **Drafting Production Manual**—for better and faster drafting, with do-it-yourself slide rule for flange and fitting drafting data. 24 pages—$1.25: Reprint **R31**

- **The Heat Exchanger**—Special Report on design, costs and types. 32 pages—$1.00: Circle **R8**

- **Clip•n•File Sheets**—$0.20 each, any 6 for $1.00. Process Data Sheets (PDS's) are 3-page fold-outs. Engineering Data Sheets (EDS's) are 2 pages on special, heavy paper for repeated handling and reference:

PDS 16,	**Chemico Nitric Acid**	**R41**
PDS 17,	**H_2SO_4 Alkylation**	**R44**
PDS 18,	**Process Reference List—1954**	**R48**
PDS 19,	**Powerforming**	**R51**
PDS 20,	**Cumene**	**R54**
PDS 21,	**HF Alkylation—Phillips**	**R56**
EDS 15,	**Combustible Vapors**	**R42**
EDS 16,	**Instrument Terminology—A-F**	**R42**
EDS 17,	**Instrument Terminology—G-P**	**R49**
EDS 18,	**Instrument Terminology—R-Z**	**R52**
EDS 19,	**Unfired Pressure Vessel Code**	**R55**
EDS 20,	**Wire Rope**	**R57**



Coupling handles all mis-alignments

Resembling a low-pressure tire in many respects, the new Para-flex coupling is designed to handle angular mis-alignment, parallel mis-alignment, and end-float in connections between drive and driven power of transmission machinery. This flexible member also cushions shock loads and reduces torsional vibration.

The heart of the coupling is a tire with synthetic fiber tension members bonded together in rubber. It is clamped between two hubs which are mounted on the shafts to be coupled. The tire has a transverse split molded into it to permit easy installation or replacement. Taper-Lock bushings on both hubs give the equivalent of shrunk-on fit on the shaft and permit quick installation to shafts of different diameter.

Para-flex will take angular mis-alignment up to 4 degrees, parallel mis-alignment up to ⅛-in., and end-float up to 5/16-in. Because there is no metal-to-metal contact, the coupling requires no lubrication. This coupling was first used in West Germany and has been adapted to American standards by **Dodge Manufacturing Corp.,** Mishawaka, Ind.

Circle No. **1** *on Reply Card*

Heat-treated glass

. . . becomes a crystalline material with amazing properties. It is lighter than aluminum, harder than carbon steel and 9 times stronger than plate glass. It is nonporous and resistant to alkalis and acids.

Pyroceram is formed from a glass batch containing one or more nucleating agents. It is melted, formed and cooled as any conventional glass (at the left). But then by successive heat treatments, the nucleating agents form billions of submicroscopic crystallites which act as the center of crystals as the heat continues. The result is an end product (near left) harder than most ceramics and many metals. Tests so far have shown that physical properties can be altered by the heat treatment, with flexural strengths up to 40,000 psi possible. Some types of Pyroceram will retain their high strength at temperatures up to 1300° F. **Corning Glass Works,** Corning, N. Y.

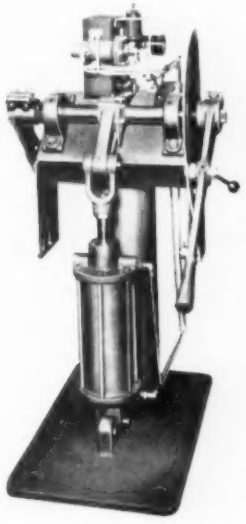
Circle No. **2** *on Reply Card*

Oil refinery model

. . . is an eye-catching exhibit. Multicolored light rays whirl upward in this scale reproduction of a primary distillation unit, symbolizing heated vapors. The scale fractionating towers with an outside finish of aluminum have a translucent cut-away that shows bubble trays inside.

The refinery model is mounted on a black wooden base and stands 27 in. high. It is 28 in. long and 15½ in. deep. A self-contained motor, with a push-button switch, provides light and power for this educational exhibit. Cost is $190 including express charges. **American Petroleum Institute,** Department of Information, 50 W. 50th St., New York 20, N. Y.

Circle No. **3** *on Reply Card*



Pneumatic drive

. . . for butterfly valves, dampers, control valves and other large controls can be adjusted with linear, square or square-root characteristics—or be field characterized for special applications.

The drive unit, which is totally enclosed, varies in size from 4 to 8-in. bore and 8 to 12-in. stroke, and has torque ratings from 265 to 850 ft lb. All five new models have a 90-degree angular rotation, are equipped for manual operation, and consume 1.5 scfm of air at 80 psig. Positioning accuracy is better than 0.2%.

The power piston is of corrosion-resistant materials, with ram shaft of chrome-plated steel and cylinder of seamless aluminum tubing. Seal packing and piston cups are neoprene. **Copes-Vulcan Division,** Blaw-Knox Co. Erie, Pa.

Circle No. **4** *on Reply Card*

(Continued on p. 130)

Temperature indicator

Responds within two seconds

Very rapid fluid-temperature measurements can be made at closely differentiated points in a liquid with this Model CTL indicator. It combines an indicating meter with a stainless-steel probe 12-in. long. A flexible armored cable of 30-in. length connects the two units.

Because only the extreme tip of the stainless-steel probe is heat sensitive, it is possible to make exploratory measurements throughout the liquid for temperature differences. Response of the highly-damped indicator is about two seconds, and accuracy is 5%. Ambient temperature variations are automatically compensated for. Four ranges are available: 0-300, 0-450, 0-650, and 0-100° F. Corresponding centigrade readings are on the instrument scale. **Royco Instruments,** 720 Arthur St., Albany, Calif.

Circle No. **5** *on Reply Card*

Patented seal

. . . **for floating roof tanks** uses a two-point suspension hanger for easier installation. Maintenance is expected to be less because of the simple construction.

This new shoe-type seal exerts a uniform pressure over the entire height of the shoe and reduces abrasion at any one point. All of the operating mechanism is beneath the roof, leaving the deck clear. There is no size limitation and the seal has been successfully installed on a 20-ft diameter floater for storing highly aromatic research gasoline. It can be installed on double-deck, pontoon and fan-type roofs fabricated by the company, or installed on any existing floating roof. **Nooter Corp.,** 1400 S. Second St., St. Louis, Mo.

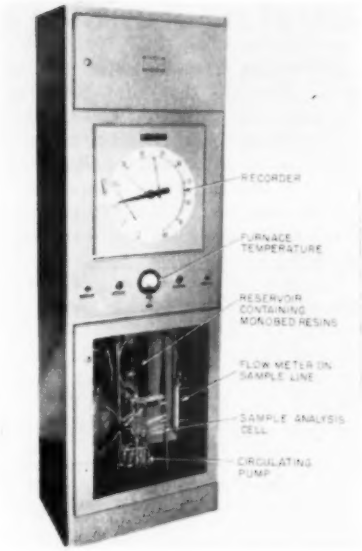
Circle No. **6** *on Reply Card*

Liquid lock nut

. . . **converts all fasteners** into lock fasteners. "Loctite" is a liquid that hardens automatically between closely fitting metal parts to form a tough plastic bond. When used on standard threaded fasteners this sealant prevents vibration from shaking them loose but still permits unlocking with ordinary tools.

Five grades of Loctite are available with the following shear strengths: 750-1000 psi, 300-400 psi, 150-200 psi and 75-100 psi. The correct grade can be determined from experimental data. When fully hardened this material resists attack by water, oil, solvents and most chemicals. It can be used at temperatures up to 300°F, and withstands thermal cycling from −65 to 300°F. **American Sealants Co.,** 103 Woodbine St., Hartford 6, Conn.

Circle No. **7** *on Reply Card*

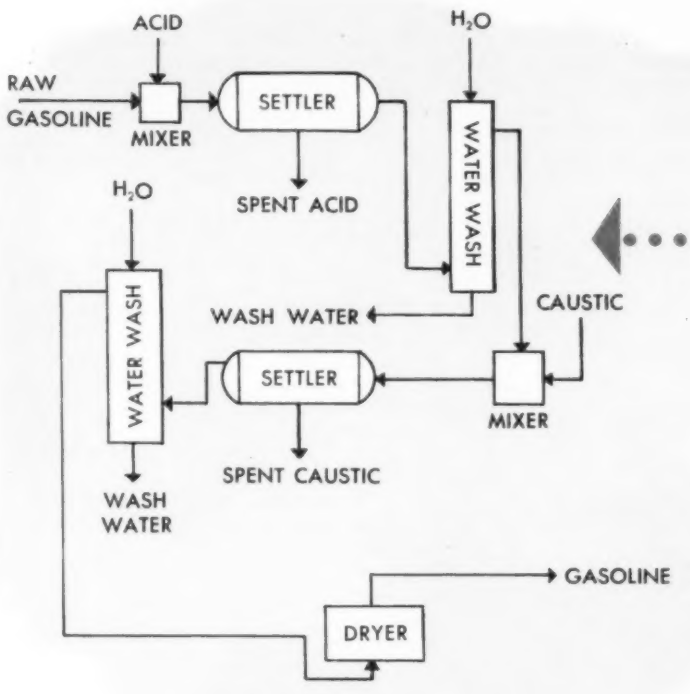


Continuous gas analyzer

. . . **uses built-in ion exchange** system to reduce the demand for a large supply of deionized water. The deionized water that is used in the analysis cell is reclaimed on a continuous basis.

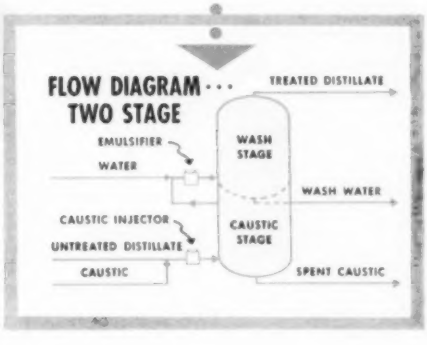
Electro-conductivity analyzers are often used in monitoring gas and vapor concentrations for air polution work, leak detection, solvent recovery and product-purity analysis. The method of detecting gases is injecting samples into a deionized water stream, and measuring the amount of conductivity of the water before and after the gas samples are injected. This procedure demands a constant source of high-quality water. By using a miniature Monobed ion exchange system installed in the gas analyzer cabinet, it is possible to eliminate the expense

if you acid treat or caustic wash...



YOU CAN REPLACE THIS

WITH THIS



PETRECO ELECTROFINING

saves space, pumps, piping and vessels

Electrofining, as pioneered by Petreco, is a continuous, precision controlled operation that is superior in every way: *easier*, because it affords efficient, once-through treatment; *cheaper*, because it requires but one vessel as compared with the 3 or 4 in conventional systems, as well as proportionately less piping, pumps or ground area; *faster*, because it delivers sharp, clean separation of hydrocarbon and caustic-wash phases, cuts settling time from days to hours. The result is a *finer finished product*, ready for market.

Write for FREE COPY *on* "PETRECO ELECTROFINING—*A New Concept in Light Oil Refining.*"

PETRECO

A DIVISION OF PETROLITE CORPORATION

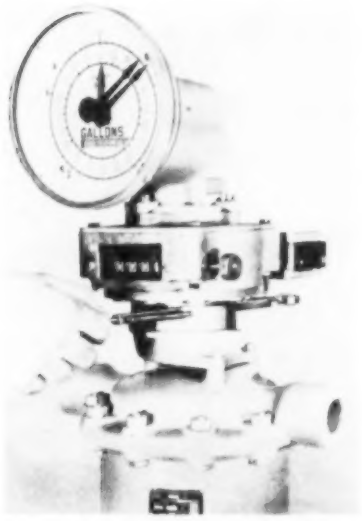
3202 SO. WAYSIDE DRIVE, HOUSTON 1, TEXAS • 1390 EAST BURNETT STREET, LONG BEACH 7, CALIFORNIA

Specialized Electric Petroleum Treating

DESALTING • DEHYDRATING • CAUSTIC WASHING • ACID TREATING • DOCTOR TREATING • SWEETENING • NAPHTHENIC ACID REMOVAL • SEDIMENT REMOVAL

of a large source of deionozed water and the required drainage lines. **Davis Instruments,** 47 Halleck St., Newark 4, N. J.

Circle No. **8** *on Reply Card*

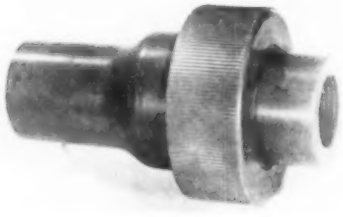


Metering control system

. . . cuts off liquid flow at the meter and all pumping action after delivery of a predetermined liquid amount. When the predetermined amount has been delivered, a switch opens an electrical circuit to cut off the pump and close the valve.

Mounted in an explosion-proof housing, the system includes an accessory control switch, a predetermined register and latch box, and a quantity control valve which can be mounted at the meter. When repeated deliveries of a fixed amount are required, a factory-set register is available to save time on resetting after each run. Meter and Valve Div., **Rockwell Manufacturing Co.,** 400 N. Lexington Ave., Pittsburgh 8, Pa.

Circle No. **9** *on Reply Card*



Lift check valve

. . . of polyvinyl chloride operates in vertical or horizontal position, and requires six pounds of pressure for operation. The valve's only moving part is a self-energizing disc.

Made of normal impact PVC, the check valve is available in sizes ranging from ½ to 3 in., in threaded or socket welding types. A pipe union type of assembly permits easy removal of the valve from the line for servicing, when required. Tests to date have indicated that this check valve, carrying a 10-15% sulfuric acid solution in a temperature range of 50-57°F, will give better performance than brass or stainless-steel valves. **Tube Turns Plastics, Inc.,** 2929 Magazine St., Louisville 11, Ky.

Circle No. **10** *on Reply Card*

Lapping machine

. . . produces surfaces accurate to 11.6 millionths of an inch, and is portable for site relocation.

The Lap-King is specially designed to relap its own plates, one against another, after a normal run—thus assuring consistently optically-flat surfaces. An hour meter records the lapping time, with an automatic timer permitting job time control. This low-cost precision machine is designed for lapping mechanical seals, as well as for other uses in refineries and power plants. **Byron Jackson Pumps Inc.,** Box 2017, Terminal Annex, Los Angeles 54, Calif.

Circle No. **11** *on Reply Card*

Control valve unit

. . . includes a bypass within itself, eliminating the need for block valves and separate bypass valve.

The unit is designed so that repair or replacement of the valve seats can be done while operating under line pressure. This will permit welding the valve directly into the flow line, saving matching flanges and gaskets. The Elsey Control Valve is available in two ratings: 400-lb, W.O.G., made of ductile iron; and 300-lb (ASA) made of steel. Sizes available from stock range from ½ to 12 in. **Elsey Corporation,** Drawer 841, Bartlesville, Okla.

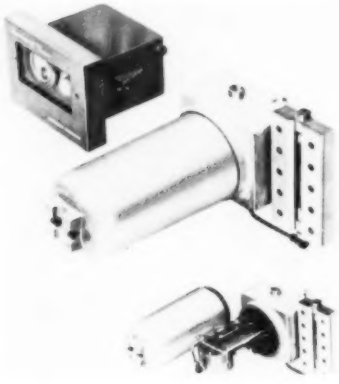
Circle No. **12** *on Reply Card*

Powdered acid

. . . removes rust, scale and corrosion from metal surfaces with safety. Solutions of the compound may be used cold or heated to 165°F for faster action. When added to water in concentrations up to 8 oz/gal, Oakite Dryacid goes into solution quickly.

The new dry cleaning compound can be shipped and stored easily; it has a mild, aromatic and non-fuming odor, and is safe to use on aluminum, brass and galvanized surfaces when recommended directions are followed. **Oakite Products, Inc.,** 1500 Rector St., N.Y., N.Y.

Circle No. **13** *on Reply Card*



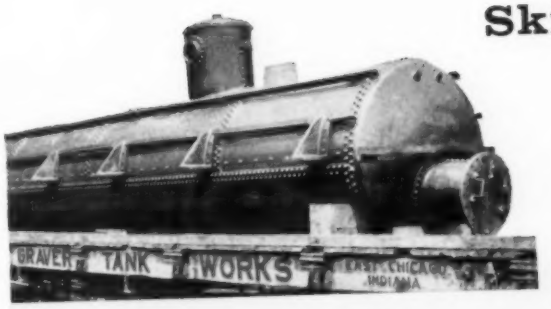
Electrolytic hygrometer

. . . measures the moisture in a process stream by electrolyzing all moisture in the stream. Current required for this electrolysis indicates the precise amount of moisture.

The unit automatically and continuously measures with 5% accuracy moisture concentrations in the 0-1000 ppm range at temperatures up to 100° C. A contact meter and relay in the instrument can be set to sound an alarm for any point in the instrument's range. For corrosive gases, Type 316 stainless steel is used in the flow system; otherwise copper or brass is used. Process Instruments Div., **Beckman Instruments, Inc.,** 2500 Fullerton Road, Calif.

Circle No. **14** *on Reply Card*

(Continued on p. 134)



Skilled Then... in Quality Riveting As Today... in Quality Welding

Riveted Semi-elliptical Fire Still—1919

-GRAVER-

— 50,000 —
—100,000—
—150,000—

GALLON TANKS (like cut) IN STOCK
For PROMPT SHIPMENT & ERECTION
WRITE for PRICES & SPECIFICATIONS

In **1857** with a small shop and all hand tools, we demonstrated our ability to make **good** tanks. In **1913** with a large plant most fully equipped with modern power tools, we are able to demonstrate our ability to make **better** tanks. The passing years have taught us many things, but best of all they have demonstrated to the trade in general the soundness of our early theories on tank construction.

STEEL TANKS AND PLATE WORK

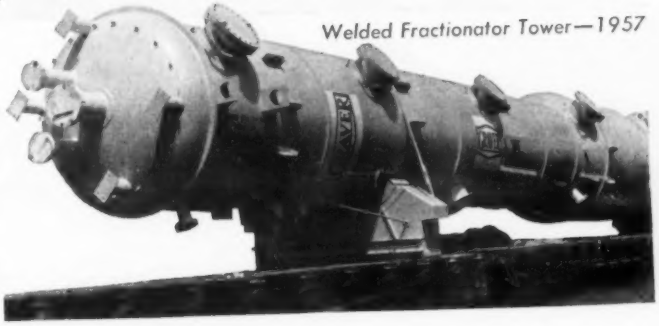
Material in stock for small tanks of 500 to 20,000 gallons capacity

WM. GRAVER TANK WORKS
EAST CHICAGO, IND. (148th and Todd Ave.)

DENVER, COLO., 1718 California St. | SALT LAKE CITY, 109 West Second St. | LOS ANGELES, CAL., 312 Security Bldg.

Some of the many types of riveted fabrication by Graver, as advertised in National Petroleum News, July, 1913

Welded Fractionator Tower—1957



Joining plate with rivets for processing equipment, pressure vessels and storage tanks would be quite unsatisfactory today. Yet, before welding became an accepted fabricating technique, to which Graver contributed measurably in perfecting, Graver's boring and riveting methods were recognized as the most advanced in the country. Today, the most advanced welding, X-ray testing, stress-relieving and assembly methods are employed. This is what you can always expect from Graver—a pioneer in skilled steel and alloy fabrication for 100 years!

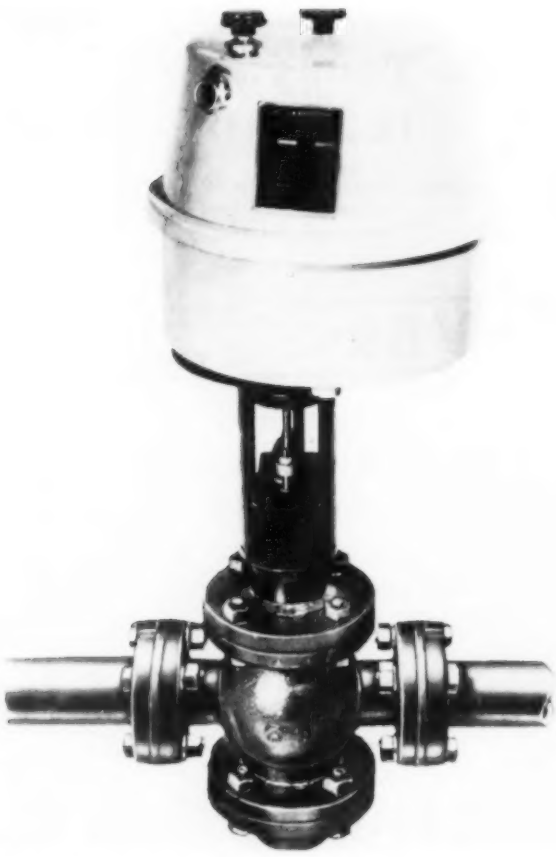
1857-1957 GRAVER® Our 100th Year

Building for the Future on a Century of Craftsmanship in Steels and Alloys

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA • NEW YORK • PHILADELPHIA • EDGE MOOR, DELAWARE
PITTSBURGH • DETROIT • CHICAGO • TULSA • SAND SPRINGS, OKLAHOMA
HOUSTON • NEW ORLEANS • LOS ANGELES • SAN FRANCISCO • FONTANA, CALIFORNIA

(To obtain more data on advertised products see page 126)



Hydraulic valve actuator

Operates from low-level input signals

To be exhibited for the first time in September in Cleveland at the Instrumentation Show, this self-contained electrohydraulic valve actuator operates directly from input signals of 1 to 5, or 4 to 8 milliamperes DC. For AC signals, a rectifier mounted inside the housing acts as a converter.

The actuator can be mounted on any sliding-stem valve having a stroke from ½ to 1½-in. and requiring less than 200-lb thrust. The electrical connections include only the two signal wires from a controller or measuring element, and two wires for power supply. The driving force is an oil pump which pumps a controlled stream through the jet pipe relay unit, which opens or closes the valve. **Askania Regulator Co.,** 240 East Ontario St., Chicago 11, Ill.

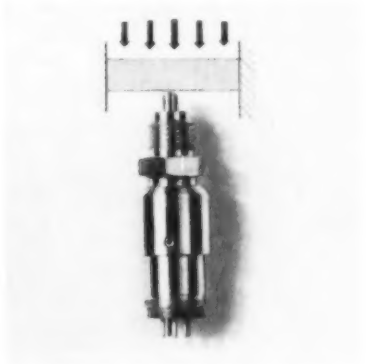
Circle No. **15** *on Reply Card*

Transistorized power

. . . for two-way radio systems replaces the vibrator power supply which often needs frequent replacement. The new transistorized power supply is claimed to have a life expectancy equal to that of the entire mobile set, thus assuring greater reliability.

Designed around a printed wiring board, the unit measures 3½ x 4 x 1¾ inches. It is light-weight—12 oz—and small enough to be mounted on the front exterior of a standard General Electric two-way radio case. It may be used with any standard make of mobile equipment using a 12-volt power source in the 25-54-mc, 144-174-mc, and the 450-47-mc bands. **General Electric,** Communication Products Dept., Syracuse, N.Y.

Circle No. **16** *on Reply Card*



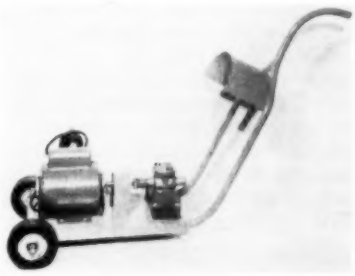
Strain gage

. . . measures forces where the deflection caused by the force is less than 0.00035 of an inch. Either compression or tension forces can be measured.

This new pickup consists of a force probe, an unbonded strain-gage, and an electrical strain-gage connector built into a small, sturdy cylinder. In operation, the unbonded strain-gage provides a high-voltage output signal of 3.33 millivolts or more, per excitation volt under maximum deflection.

Force pickups can be obtained in ranges from 0 to 5 lb up to 0 to 2,000 lb. Excitation may be 6, 12 or 15 volts, AC or DC. Hysteresis is 0.25% maximum, full scale. Temperature range is —65 to 350°F. **Dynamic Instruments Co.,** 28 Carleton St., Cambridge, Mass.

Circle No. **17** *on Reply Card*



Pump dolly

. . . with mounted pump can be used in narrow quarters for temporary service. Weighing only 50 lb with pump

One of a series.

An Inside Peek at Steam Trap Capacity Ratings

or... how to be sure steam heated equipment is going to work the way it's engineered

WHEN YOU GET all through engineering a steam heated process equipment installation, its performance will depend on whether your steam traps will do what the catalog said.

Now, in theory, if you know the size of a steam trap orifice, you can figure how much water can be pushed through it in a given time by a given steam pressure. But, in practice, this doesn't work out. The picture is scrambled by things like the choking effect of flash steam and restriction of flow through the trap and piping.

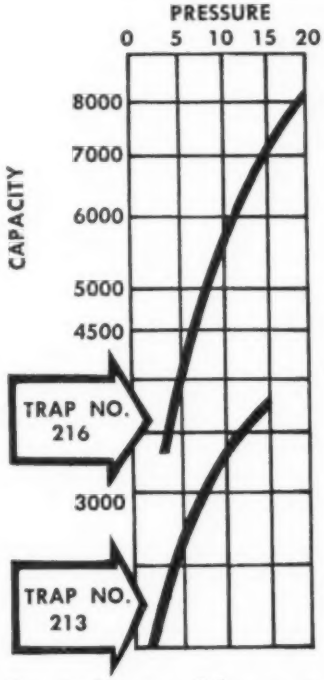


Fig. 1—Showing difference in volume of condensate discharged by a No. 216 trap with 2" pipe connections and a No. 213 trap with ¾" pipe connections—each trap having ½" discharge orifice.

For example, Fig. 1 shows that a ½" orifice in a 125 psi No. 216 Armstrong steam trap with 2" pipe connections will discharge 7200 lb/hr condensate at 15 psi inlet pressure. Yet, a ½" orifice in a 15 psi No. 213 trap with ¾" pipe connections, discharges but 3900 lb/hr at 15 psi inlet pressure. The difference: pipe friction.

Thus, we see a need for investigating the basis for steam trap capacity ratings. Unfortunately, they are not all arrived at in the same way. If they are based on cold water tests, producing no flash steam, they are much too high. Orifice tests are also too high because they ignore pipe friction. Calculations involving flow-through-orifice formulae have never been known to be conservative insofar as traps are concerned.

Armstrong Ratings

Armstrong trap capacity ratings are based on actual operating conditions, determined by hundreds of tests. In these tests condensate at the steam temperature corresponding to test pressure was used. Restriction of flow caused by the choking effect of flash steam, as well as the back pressure created by flash steam and condensate, automatically were taken into account. Actual installation hookups were used, so that pipe friction in both inlet and discharge lines also was reflected in the results.

All this effort assures you the nice, comfortable feeling that comes from knowing a trap will deliver on the job the full capacity claimed in the catalog.

* * *

There is one more ingredient that needs to be tossed into the trap-sizing pot. This morsel is the safety factor—the required excess of trap capacity over calculated condensate load. It will be the subject of the next advertisement in this series. But, in the meantime, if you'd like to get the lowdown, ask for a copy of the 44-page Armstrong Steam Trap Book. It is a complete guide to good trapping practice. It covers not only safety factors, but calculation of condensate loads and trap selection, installation, troubleshooting and maintenance. Just call your local Armstrong Factory Representative, or write: **Armstrong Machine Works, 8264 Maple St., Three Rivers, Michigan.**

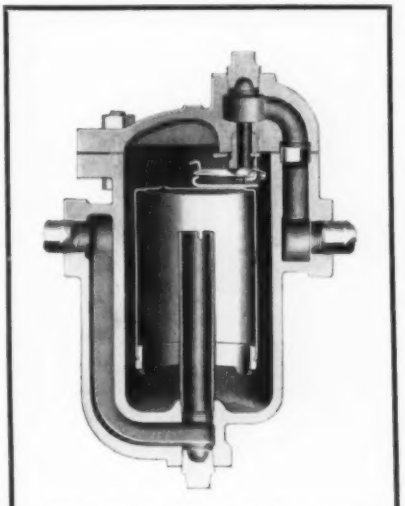


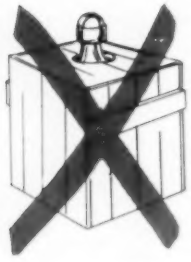
Fig. 2—Armstrong inverted bucket steam trap—hardened chrome steel valve and seat—stainless steel lever and bucket—simple, dependable, long-lived.

ARMSTRONG STEAM TRAPS

(To obtain more data on advertised products see page 126)

Tired of playing
'Carboys and Injuries'?

Descale with Oakite DRYCID!



Here's a new Oakite development for the petroleum industry — a rust and scale remover in powder form.

Look at all the handling you save. One pound of Oakite DRYCID, mixed with water, makes two gallons of effective descalant solution. That means no heavy carboys to cart around, store, uncrate and return. No breakage losses, either. And it has a pleasant aroma ... not pungent, like the fumes usually associated with liquid acids.

Inhibited Oakite DRYCID removes iron sulphides, water scale, rust and other metal oxides. It offers the safest, most convenient way to descale heat exchangers, diesel water-cooling systems, and similar equipment ... to derust valves, fittings, steel shaft casings, chains, etc.

For more information about Oakite DRYCID, write to Oakite Products, Inc., 50D Rector Street, New York 6, N.Y.

Technical Service Representatives in Principal Cities of U. S. and Canada

SPECIALIZED INDUSTRIAL CLEANING
OAKITE.
MATERIALS · METHODS · SERVICE
SCIENCE

Export Division Cable Address: Oakite

What's new (continued)

and motor, the dolly provides a rigid, vibration-free base for the pumping unit.

Pumps are available in many corrosion-resistant materials, with capacities up to 10 gpm and 75 psi. Motors may be specified from any standard type, including explosion-proof and air-motor drives. Also available in a combination unit is a portable pump of Carpenter 20 stainless steel with capacity of 40 gpm and heads up to 50 ft. **Eco Engineering Co.,** 12 New York Ave., Newark 1, N. J.

Circle No. **18** *on Reply Card*

Aluminum alloy

. . . of high strength is now available for welded structures operating at temperatures of 150 to 300°F. It has high resistance to corrosion and to stress corrosion in all temper specifications, and has no cold-forming restrictions.

Alloy X5454 can be arc welded with joints having tensile strengths equal to that of the alloy in the annealed condition. On thicknesses up to ½ in. the inert-gas tungsten method

CLASSIFIED

CONSTRUCTION MANAGER

Well established midwest engineering firm has responsible position available for manager of its construction activities. This is a high level management position, requiring capable individual with approximately 10 or more years' experience in the management and supervision of field construction of chemical or petroleum processing units. Salary commensurate with experience and proven ability. Replies will be treated in confidence.

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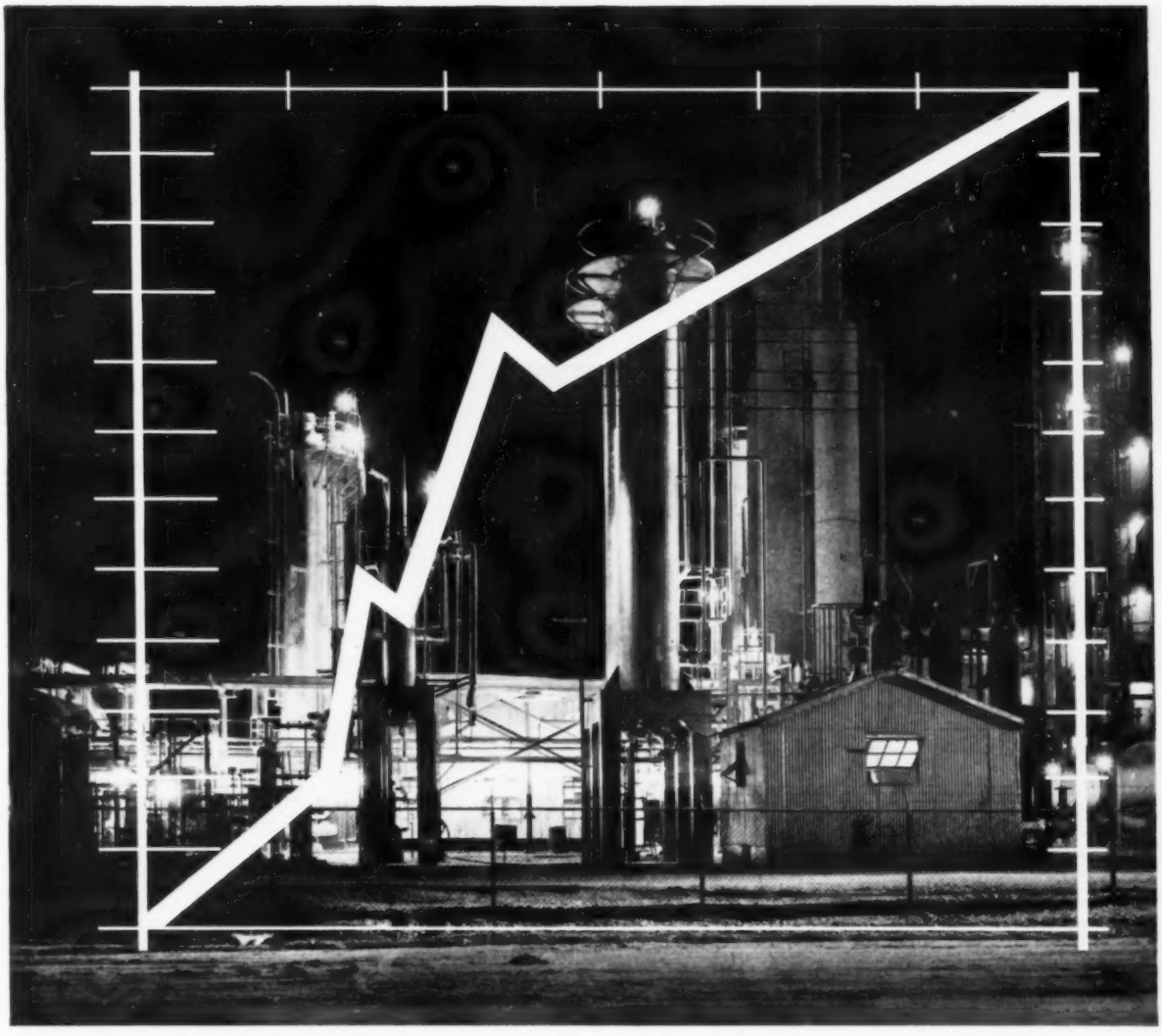

If you are boosting capacity . . .

New refining processes usually call for completely new equipment or drastic revamps of existing facilities.

That's why it's a good idea to get in touch with Bigelow-Liptak when furnace enclosures are being considered. Modernization of your present equipment will assure keeping pace with production demands and save money to boot.

When new enclosures are needed, B-L can design—furnish quality controlled materials—and erect. One source for everything—one responsibility for the job—saves you plenty in the long run.

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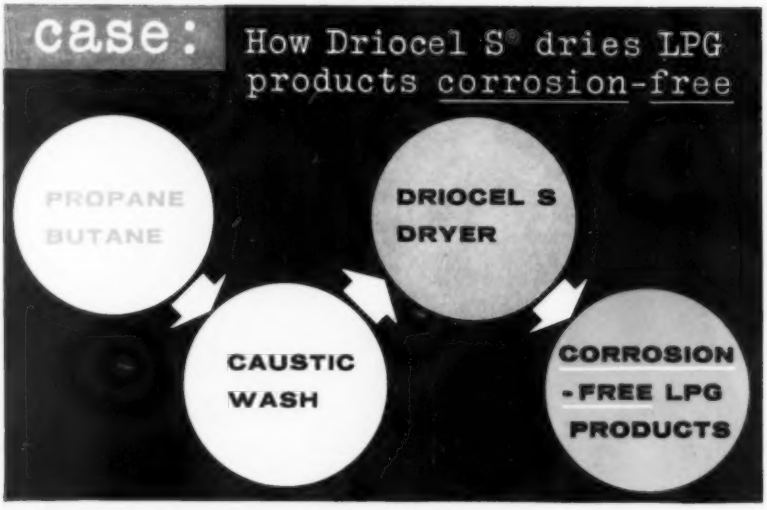
(To obtain more data on advertised products see page 126)

MIN CHEMISTRY *at work*

case: How Driocel S® dries LPG products corrosion-free



Desiccant Report: Driocel S is a low-cost, long-service-life drying agent. M & C developed it to overcome corrosion of LPG products in the final drying step. It works three ways:

1. *Does a thorough job of drying.*
2. *Does not* exhibit a corrosive reaction with sulfur compounds which escape caustic wash, are in the pre-dryer stream (which may even test "pass"), and then are decomposed in the dryer by ordinary desiccants to yield corrosive products.
3. *Does not* polymerize unsaturates under normal drying conditions.

Specific properties of Driocel S also suggest its use in the drying of chlorinated and fluorinated hydrocarbons.

Our business is to supply low-cost nature-given materials that are process-engineered to make things go smoothly in your plant . . . well in your markets. Use the coupon.

MINERALS & CHEMICALS CORPORATION OF AMERICA
5515 Essex Turnpike, Menlo Park, N. J.

I'm interested in a natural mineral product in petroleum processing for _____

Send: ☐ Detailed desiccant literature ☐ Free samples

name _____ title _____

company _____

address _____

city _____ zone _____ state _____

For more data, see Refinery Catalog, Pages 618-619.

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CORPORATION OF AMERICA
5515 Essex Turnpike, Menlo Park, N.J.

Leaders in creative use of non-metallic minerals
ATTAPULGITE (*Attapulgus*)
ACTIVATED BAUXITE (*Porocel*)
KAOLIN (*Edgar • ASPs*)
LIMESTONE (*Chemstone*)
SPEEDI-DRI FLOOR ABSORBENTS

can be used. Sheets and plates of the new alloy have tensile strengths varying from 36,000 to 49,000 psi, depending on the temper. **Aluminum Company of America,** 798 Alcoa Bldg., Pittsburgh 19, Pa.

Circle No. **19** *on Reply Card*

Free trade literature

Drafting tips

. . . for greater efficiency: *Time Saving Tips for the Draftsman and Engineer* is a collection of 59 shortcuts for saving drafting time without sacrificing precision. Included are 22 drafting shortcuts, 9 engineering data tips, 18 board timesavers and 10 calculating ideas. Frederick Post Co., 3650 N. Avondale Ave., Chicago 18, Ill.

Circle No. **20** *on Reply Card*

Floating-roof tanks

. . . for product conservation: *Catalog 57R* is a 22-page booklet specifying the need for conservation measures in storing hydrocarbons, and some of the equipment this manufacturer can supply for the purpose. Described are the several types of floating roofs, two types of seals, and the standard equipment supplied with all floating-roof tanks. Hammond Iron Works, 744 Broad St., Newark 2, N. J.

Circle No. **21** *on Reply Card*

Sonic gas analyzer

. . . how it operates and how it can be used: *Bulletin 175* explains the principle of operation of this accurate gas analyzer, which can measure as low as 0.0005% oxygen in air and 0.00061% of hydrogen. The sonic gas analyzer is especially suited for gas and vapor chromatography because of its high sensitivity to all gases in a helium or hydrogen carrier. National Instrument Laboratories, Inc., 6108 Rhode Island Ave., Riverdale, Md.

Circle No. **22** *on Reply Card*

Brass tube fittings

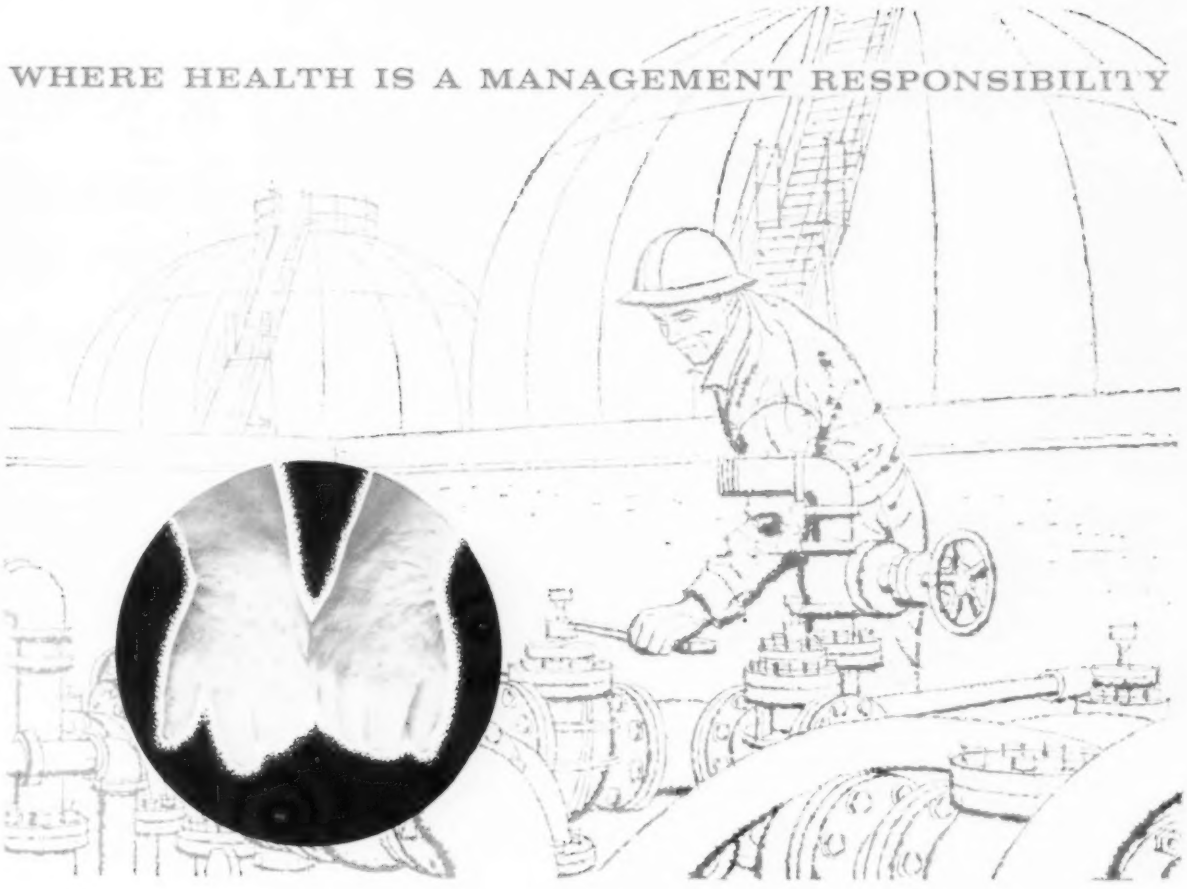
. . . and how to install them: *Form 6073* is a 49-page catalog not only on brass tube fittings but drain and shut-off cocks and push-pull cable controls. Suggestions on installing a tubing system are included. The Weatherhead Co., Fort Wayne, Ind.

Circle No. **23** *on Reply Card*

Storage-tank fittings

. . . to reduce evaporation: *Catalog No. 66* describes a new line of brass fittings designed especially for storage

WHERE HEALTH IS A MANAGEMENT RESPONSIBILITY



DERMATITIS is a needless penalty

Dermatitis in petroleum plants can be prevented. Simply. Inexpensively. With a basic program that safeguards and improves the hygiene of workers — the West Program of Dermatitis Prevention and Control.

How does it work?

No contributing source of dermatitis is overlooked. Specially formulated handcleaners insure personal cleanliness. Antiseptic creams help protect exposed skin areas. "Vinylite" aprons and armguards prevent clothing contamination. Other specialties protect against bacteria infections.

Workers are protected against physical discomfort, lowered morale and lost time.

Management is protected against the costs of medical care, absenteeism, replacement training, sacrificed quality and lost production.

Why not discuss the West Program of Dermatitis Prevention and Control with one of our specialists? His recommendations will help you eliminate the needless penalty of dermatitis. No obligation of course. Just send the coupon.

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WEST DISINFECTING DIVISION

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☐ Please send your 24 page booklet "The Control of Dermatitis in Industry."
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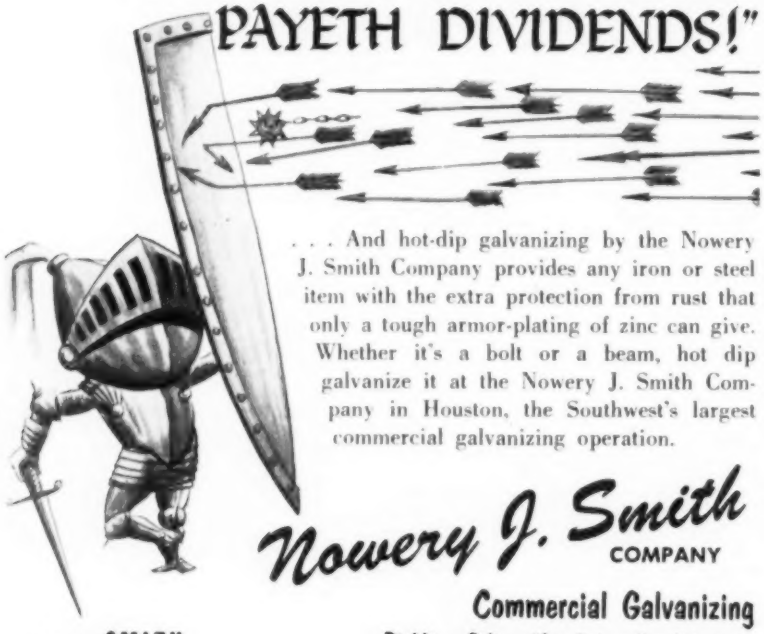
Quoth Sir Galva-Knight:

"EXTRA PROTECTION PAYETH DIVIDENDS!"



. . . And hot-dip galvanizing by the Nowery J. Smith Company provides any iron or steel item with the extra protection from rust that only a tough armor-plating of zinc can give. Whether it's a bolt or a beam, hot dip galvanize it at the Nowery J. Smith Company in Houston, the Southwest's largest commercial galvanizing operation.

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tanks. Gage hatches with automatic closing and vapor-tight sealing, screened air vents, breather vents with diaphragm seals, and water-drain valves with steel bodies and resilient seats are some of the newly-designed fittings. Wheaton Brass Works, Union, N.J.

Circle No. **24** *on Reply Card*

Valve catalog

. . . covering gate valves, check valves and fire hydrants: *Catalog No. 57* is a 244-page book with many illustrations and diagrams. In addition to the complete listing of all valves made by this manufacturer, the book contains a 36-page section of engineering data useful in the design of valved piping systems. Another section useful to the designer or engineer is a section on material specifications and standards for valves. Darling Valve & Manufacturing Co., Williamsport, Pa.

Circle No. **25** *on Reply Card*

Plastic pipe and fittings

. . . made of polybutadiene-polystyrene acrylonitriles: *Rigid High Impact Plastic Pipe and Fittings, Form No. 10M-557* is a technical catalog on this product. Included are tables on physical properties, electrical properties, corrosion resistance and friction loss. Suggestions for machining and joining this pipe are also included. Triangle Conduit & Cable Co., Inc., New Brunswick, N.J.

Circle No. **26** *on Reply Card*

Electromagnetic control

. . . equipment: *Catalog 57-S* is a 7-section catalog on the following electromagnetic equipment:

Section 1—Automatic transfer switches
Section 2—Remote-control switches
Section 3—Contactors
Section 4—Relays
Section 5—Solenoids
Section 6—Electric plant controls

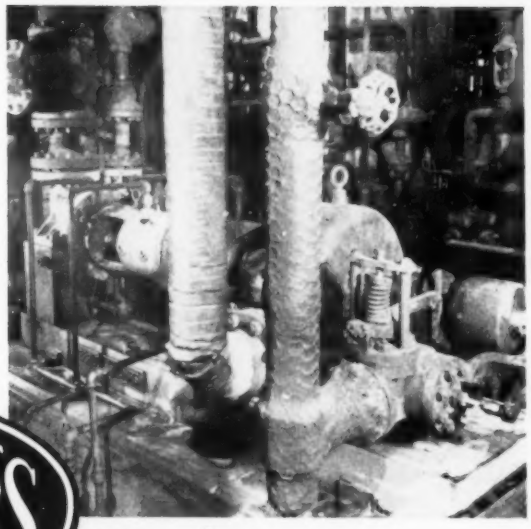
Complete data is provided in all sections, including electrical specifications, constructional information, and dimensions and weights of components. The sections may be requested separately or the entire 170-page catalog may be obtained by writing on company letterhead to Automatic Switch Co., Florham Park, N.J.

Do not use Reply Card

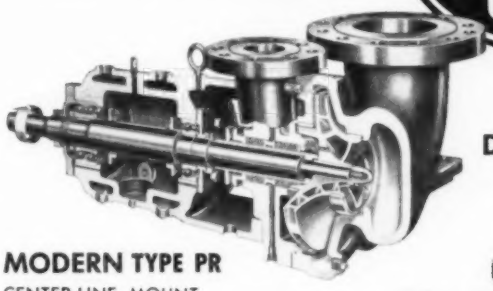
Oil coolers

. . . conforming to ASME Code requirements: *Bulletin 12C* is a small but information-packed bulletin on

GET THE Modern Design OF PEERLESS PUMPS... FOR *Dependable Pumping* OF REFINERY PROCESS LIQUIDS



PEERLESS PUMPS



Modern TOP AND END SUCTION *and* TOP DISCHARGE DESIGNS IN BOTH TYPES FOR CONTINUOUS DUTY SERVICE IN MODERN REFINING PROCESSES

USE THE HORIZONTAL TYPE PR PUMP WHERE YOUR APPLICATION REQUIREMENTS ARE: Rugged Center-Line-Mount Construction; High Temperatures; High Pressures; High Capacity; Extra Low NPSH Requirements; Optional Use of Mechanical Shaft Seal or Packing Gland Construction; End or Top Suction Design; Dependable Performance with Minimum Maintenance; Availability in Various Alloys; A Complete Range of Sizes; Many Sizes Available from Stock in Standard Materials; Maximum Parts Interchangeability; Wide Range of Liquid Pumping Services, such as Hot Oil, Butane, Propane, Hydrocarbons, Hard-to-Handle Chemicals and Water. For descriptive Bulletin check and mail coupon.

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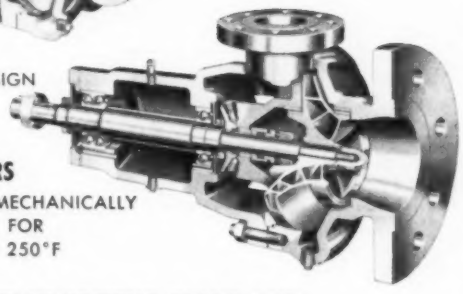
CENTER-LINE MOUNT PACKING GLAND PUMP DESIGN FOR TEMPERATURES UP TO 850°F



MODERN TYPE PRS
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TYPE PR PUMPS ARE A LINE OF PACKING GLAND AND MECHANICALLY SEALED PROCESS PUMPS with these Specifications —

Capacities: up to 1200 gpm.

Operating Heads: up to 675 feet.

Temperatures: Type PR (Packing gland construction) up to 850°F; Type PRS (Mechanical Shaft Seal Construction) up to 250°F.

Case Pressures: up to 600 psi.

Drives: horizontal electric motor is standard; others as required, such as steam turbine drive or stationary engine drive.

Materials of Construction: Liquid end can be furnished in cast iron, bronze, carbon steel, stainless steel or other materials as required for intended service.

Liquids Handled: hot oil, hot water, propane, butane and all petroleum hydrocarbons, process liquids, Dowtherm, and numerous other solutions.

NPSH Characteristics: designed to operate with minimum available NPSH.

PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION

Factories: Los Angeles, Calif. and Indianapolis, Indiana.
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PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26
Los Angeles 31, California

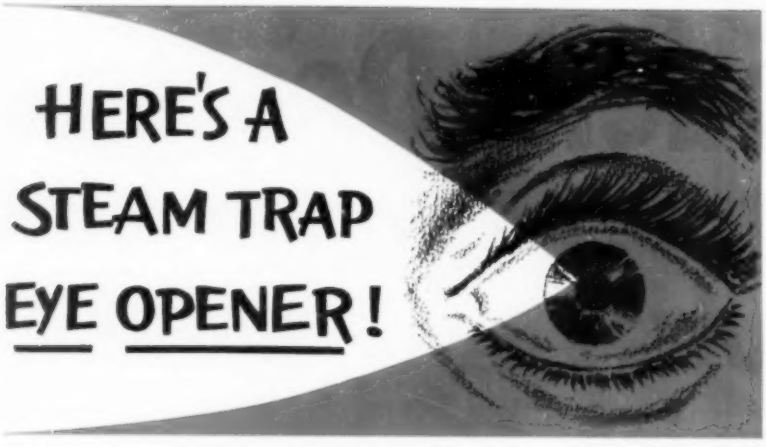
Please send us copy of Peerless Type PR Pump Bulletin No. B-1605.

NAME_____

COMPANY_____

STREET_____

CITY_____ STATE_____



● Don't be misled into thinking that one type of steam trap meets all requirements. Each type of trap has a purpose—operates efficiently only under certain conditions. The correct selection of the right type of trap for each application pays for itself by draining *all* condensate and venting *all* air in the *shortest* possible time.

ANDERSON STEAM TRAP SELECTION GUIDE

Super-Silvertop INVERTED BUCKET

For normal inside uses. More efficient since condensate, rather than temperature differentials, actuates the trap. Patented guided bucket arrangement eliminates bucket damage and assures positive seating.

Heat-Kwik COMBINATION BUCKET AND THERMOSTATIC

For extremely fast heating up. Unique combination design vents air eight times faster from cold units. Permits production units like cookers, dryers, autoclaves, kettles to reach maximum capacity in 2½ minutes.

Quik-Flex THERMOSTATIC

For all outdoor applications. Wherever a freeze-proof trap is required such as tracer lines, meter boxes, etc. Particularly recommended for refineries, chemical, petrochemical and other outdoor type plants.

Anderson FLOAT Traps

For continuous trapping. Such as ahead of condensate meters (bucket traps operate intermittently). Also for draining moisture and entrainment from *air* and *gas* pipelines, purifiers, separators and other equipment.

THE V. D. ANDERSON COMPANY

division of International Basic Economy Corporation • 1931 West 96th Street • Cleveland 2, Ohio, U.S.A.

YES I want to use the right steam trap. Please send information on the following types:

- ☐ Inverted bucket
- ☐ Combination
- ☐ Thermostatic
- ☐ Float

*Name*_____

*Company*_____

*Address*_____

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QUALITY STEAM TRAPS SINCE 1886

single and two-pass coolers. Included are data on design and operating features, material specifications, sizes and dimensions plus a handy sizing system. A nomograph for determining logarithmic mean temperature difference, together with simplified design equations, permits rapid approximation of a unit. Dept. HT-F, Schutte and Koerting Co., Cornwells Heights, Bucks County, Pa.

Circle No. **27** *on Reply Card*

Using a Gradall machine

. . . in oil refinery construction and maintenance: *Gradall Field Report No. 1* is a 16-page report of the many uses for this versatile machine, ranging from constructing fire walls to cleaning sludge from storage tanks. Typical cases and pictures of each case are included. Gradall Division, Warner & Swasey Co., Cleveland 13, Ohio.

Circle No. **28** *on Reply Card*

Teflon fibers

. . . in sheet form for severe filtering: *New Products Bulletin No. 6* lists the information currently available on a new class of products trademarked "Armalon." Made from Teflon fibers, these paper-like sheets with relatively high porosity are available in thicknesses of 5, 10 and 15 mils. The material will withstand exposure to strong acids and bases, operating temperatures from —100 to +400°F, and is unaffected by water or any of the common fuels and solvents. E. I. DuPont de Nemours & Co., Fabrics Division, Wilmington 98, Del.

Circle No. **29** *on Reply Card*

Insulation costs

. . . for 186 basic sizes and thicknesses of pipe insulation: *Manual of Plus Values* is a collection of 50 tables showing the net prices for these items of insulation, ranging from 1 to 50%, plus discount. Any of the 9300 net prices can be found by cross reference to insulation thickness and pipe size on the proper table. Copies of the manual may be obtained by writing on company letterhead to Union Asbestos & Rubber Co., 1111 West Perry St., Bloomington, Ill.

Circle No. **30** *on Reply Card*

Rotameter selection

. . . is made easy with a circular slide chart: *Bulletin 110* contains a die-cut disc which automatically locates operating temperatures and pressures for the different types of rotameters

Carbon Monoxide Boiler at Sun Oil Company's Toledo refinery.

3 B&W Carbon Monoxide Boilers Save Fuel For Sun Oil

Sun Oil Company has three B&W Carbon Monoxide Boilers in its refineries at Toledo, Ohio, and Marcus Hook, Pa. All are used with Houdriflow cracking units. The first boiler went on stream at Toledo three years ago. The second, at Toledo, and its twin at Marcus Hook, are of the oxycatalyst type.

The three B&W "CO" Boilers are effecting substantial fuel economies at both refineries.

Cracking units at Sun Oil, like others using B&W "CO" Boilers, are completely independent of outside steam and energy sources at all times. Whether or not the cracking unit is operating, steam is always available.

Extended, sustained service has proved the reliability, efficiency, and economy of B&W "CO" Boilers in refineries throughout the nation. They are flexible in design and arrangement to meet varying refinery conditions. B&W engineers can show you how a "CO" Boiler can serve your refinery, regardless of size, steam pressure and temperature requirements. The Babcock & Wilcox Company, Boiler Division, Dept. PP-2, 161 East 42nd Street, New York 17, N. Y.

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BOILER DIVISION

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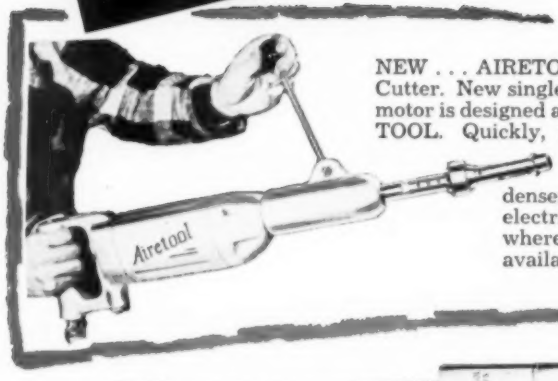
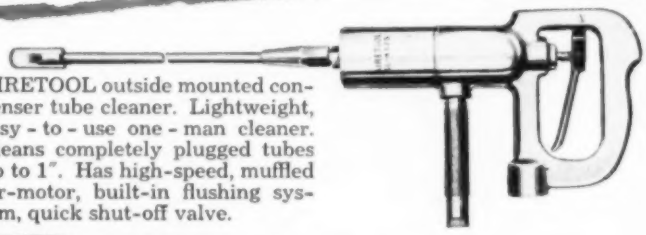
Look no further than AIRETOOL for dependable, cost-saving tube maintenance equipment. Precision made Airetool tube cutters, cleaners, expanders, accessory and specialty tools meet **every** tube maintenance need. Save time and money on **every** job.



NEW . . . AIRETOOL Internal Tube Cutter. New single-stage, air-driven motor is designed and built by AIRETOOL. Quickly, inexpensively removes damaged or leaky condenser tubes. Optional electric motor for use where air supply is not available.



AIRETOOL outside mounted condenser tube cleaner. Lightweight, easy - to - use one - man cleaner. Cleans completely plugged tubes up to 1". Has high-speed, muffled air-motor, built-in flushing system, quick shut-off valve.

AIRETOOL Automatic Tube Expansion Control . . . automatically, accurately rolls tube joints to proper tightness. Portable unit goes right to job site.

AIRETOOL Tube Removal Tools are great for retubing a bundle. Quickly and efficiently remove tubes and tube stubs from condenser tube sheets.

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BRANCH OFFICES: New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge.

REPRESENTATIVES in all principal cities of U.S.A., Canada, Mexico, South America, England, Europe, Puerto Rico, Italy, Japan and Hawaii.
EUROPEAN PLANT: Vlaardingen, The Netherlands.

Write for illustrated literature on condenser tube maintenance tools.
Ask for Bulletin #59.

available. Or, by use of a different set of indices, a suggested rotameter is specified that will fulfill certain maximum operating conditions. Brooks Rotameter Co., Lansdale, Pa.

Circle No. **31** *on Reply Card*

Centralized control

. . . of remote operations: *Bulletin 240-P2A* describes a system for remotely controlling the operation of any combination of pumps, valves, gates, generators, circuit breakers and other control devices. The system is built around the Synchro-Scan scanning switches, which permit two-way transmission of process values and return instructions for control purposes. It will permit one man to operate an entire process system by the combination of plug-in units. Builders-Providence, Inc., 345 Harris Ave., Providence 1, R.I.

Circle No. **32** *on Reply Card*

Nuclear engineering

. . . and the role of Stone and Webster Engineering Corp. in the development of it: *Engineering for Atomic Power* is a 36-page illustrated booklet describing the early development of nuclear facilities for creating fissionable materials. The early development of the Manhattan project, Oak Ridge and Hanford are touched upon in this historical recount of this company's early and current interest in nuclear engineering. Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass.

Circle No. **33** *on Reply Card*

Sodium dispersions

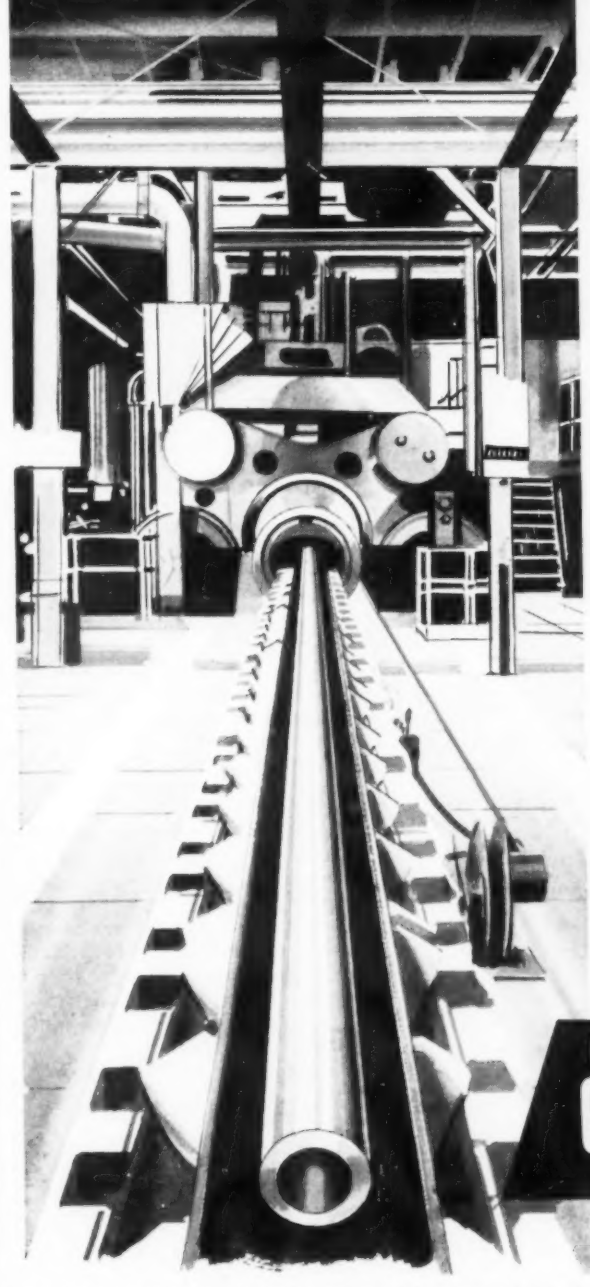
. . . for pilot and plant use: *Sodium Dispersions* is a completely revised edition of this brochure. Its 42 pages include up-to-date information on the technology of preparing and using sodium dispersions. Included for the first time is a layout and description of a method of continuous preparation of this laboratory and process aid. U.S. Industrial Chemicals Co., Division of National Distillers and Chemical Corp., 99 Park Ave., New York 16, N.Y.

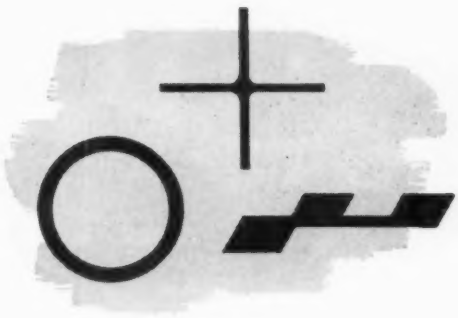
Circle No. **34** *on Reply Card*

Cost study

. . . of seamless, forged welding necks: *Lenape Topics, Vol. 2 No. 1* is an appraisal of the comparative costs of this type of pressure vessel connection. Plotted for comparison on one composite chart are costs for 150, 300,

Shaping a new future for Industry





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The 12,000 ton extrusion press and the complete facilities of Curtiss-Wright's Metals Processing Division are ready to go to work for you . . . to advance the design and production of metal products beyond the limitations of conventional equipment. Qualified engineering consultation available at all branch offices.

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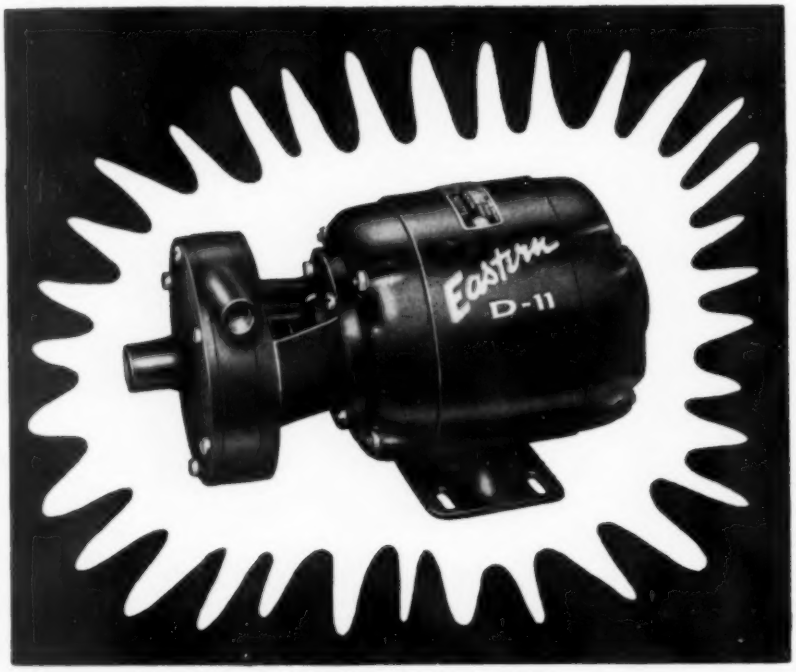

24,830 successful installations!

EASTERN D-11 CENTRIFUGAL PUMP

Why is the D-11 so successful among original equipment manufacturers? *Size and weight* make it ideal. The D-11 is the smallest, close-coupled, single-stage centrifugal pump available with an induction type motor. Eighteen pounds of compact design (9¾" x 4⅝") make it excel in industrial and process equipment, as well as laboratory service, and pilot plant operations.

SPECIAL METALS

A full selection of metals make the D-11 and other Eastern Centrifugal Pumps versatile performers. Available in 18-8 Type 303 and Type 316 Stainless Steel, Monel, Hastelloy "C", Cast Iron and Bronze, Eastern Pumps range from ⅛th to ¾ H.P. with capacities up to 70 G.P.M., pressures to 65 P.S.I.

For complete specifications on all Eastern Centrifugal Pumps, request Bulletin 120-E

Eastern INDUSTRIES, INC.
100 Skiff St., Hamden 14, Conn.

600 and 900-lb ASA necks. Included in the same report is a description of the method of making seamless necks from a single billet of steel, which is used by this manufacturer. Lenape Hydraulic Pressing and Forging Co., Dept. 180, West Chester, Pa.

Circle No. **35** *on Reply Card*

Laboratory ware

. . . of polyethylene: a 20-page catalog of the unbreakable equipment made specifically for chemical laboratory use from this versatile material. Both regular and high-temperature polyethylene ware are described and priced. For temperatures below 130°F the regular plastic is recommended; for temperature up to 250°F the newer, low-pressure polyethylene is suggested. Some 75 different items are listed and illustrated in this catalog. Harshaw Scientific Div., 1945 East 97th St., Cleveland 6, Ohio.

Circle No. **36** *on Reply Card*

Controlled-volume pumps

. . . in petroleum refining: *Bulletin No. 457* describes the latest techniques in this field. Actual chemical metering systems used in pilot and research plants, crude desalting, catalyst preparation, grease preparation and water treating are described. Other chemical feeding systems for metering product improvers, additives, dyes, antioxidants and sweeteners are illustrated. Milton Roy Co., 1300 E. Mermaid Lane, Philadelphia 18, Pa.

Circle No. **37** *on Reply Card*

Air-handling manual

. . . for propeller fans: *Bulletin E-57, Air Engineering Data File* is a 24-page folder for use by those designing or installing industrial ventilation. Helpful tables for estimating air-handling requirements, entrances and elbow losses, and duct sizes are presented. Included also are specifications for special application equipment such as propellers, coatings and motors, corrosion-resistance guides, physical fan laws, terms and definitions. Aerovent Fan Co., Inc., Piqua 57, Ohio.

Circle No. **38** *on Reply Card*

Ethyl - USA

. . . world's leading supplier of anti-knock compounds: *Ethyl—USA* is an 18-page brochure describing the industrial experience, research facilities and extra services which this company offers to the oil industry of all countries. Copies of the brochure are

one pipe insulation... UNIBESTOS®

for every temperature from 80° to 1200° F.

UNARCO

See how you save!

INVENTORIES SIMPLIFIED—only one type of insulation to stock.

EASIEST TO APPLY—standard methods, regular tools; cuts quickly without shattering or end-breakage. Refractory-coated smooth surface.

RESISTS IMPACT—virtually impervious to shock and vibration. Built to stay strong indefinitely.

WITHSTANDS MOISTURE, FUMES—insulating capacity is unchanged by long exposure to various chemical fumes. Submerged in water for weeks, it dries good as new.

POSITIVE HEAT-LOSS PROTECTION — No shrinkage; calcination and dehydration practically eliminated.

LOW THERMAL CONDUCTIVITY—means high insulating efficiency.

HEAT-TIGHT JOINTS—the fibrous nature of Unibestos leads to interlacing between sections for effective heat-sealing of joints.

SINGLE-LAYER APPLICATION—tests prove less heat loss with single-layer UNIBESTOS than with other double-layer insulations.

There's nothing like UNIBESTOS

If you're not using UNIBESTOS now, it's time to take a new look at pipe insulation. Costs come down all along the line with this all-purpose, long-lasting protection.

UNIBESTOS is quickly adapted for flanges, valves, fittings—needs no canvas cover, no additional protection within buildings. Shrinkage is negligible, even at 1200°, and it may be removed and re-used time after time without damage or loss of efficiency.

Long the world's largest selling high-temperature pipe insulation, today's UNIBESTOS is the one *all-temperature* pipe insulation. It costs no more, and only *one* insulation need be stocked on the job.

Small and thin or big and thick, sizes to 44" O.D. Made from long-fibered Amosite asbestos. UNIBESTOS assures outstanding economy, whatever the service or temperature.

HOW THICK SHOULD PIPE INSULATION BE?

Ask for UNARCO'S free 40-page Booklet F76-312 with exclusive "J" Factor Tables for easy, scientific thickness selection according to cost of fuel, hours of operation, life expectancy of installation, pipe size, temperature, and cost of insulating.

UNION ASBESTOS AND RUBBER COMPANY

1111 West Perry Street, Bloomington, Illinois

 (To obtain more data on advertised products see page 126)

*the Best**

VERTICAL COMBINATION GAS & OIL BURNER

JOHN ZINK

series

"DA"

* Oil spillage cannot cause gas burner plugging.

If the oil can be pumped, the "DA" can burn it.

No matter what calorific value gas is made available, this burner can handle it safely and quietly.

WE MAKE HEAT ...AROUND THE WORLD

For detailed information, write for Bulletin DA-357.

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JOHN ZINK COMPANY

4401 SOUTH PEORIA TULSA 5, OKLAHOMA

available from Ethyl Corp., 100 Park Ave., N. Y. 17, N. Y.

Circle No. **39** *on Reply Card*

Did you miss these?

The following items, reviewed originally in April, have aroused considerable interest among readers. They are repeated here briefly as a service to those who may have missed them the first time they appeared. For details or literature please use the regular Reply Card in this issue.

Maintenance symposium

. . . is a collection of seven pertinent articles on maintenance: *The Maintenance of Plants and Facilities* includes four articles previously published by Carl F. Braun on the importance of good maintenance equipment and program. The other articles describe layout and tooling of maintenance shops, how Esso modernized their Baton Rouge refinery, and the suggestions of three Ethyl men for the maintenance of chemical plants. Copies of this symposium are available from C. F. Braun & Co., Alhambra, Calif.

Circle No. **40** *on Reply Card*

Specific-gravity indicator

. . . uses liquid bubbler for accuracy. Operating on the principle of a differential bubbler, this remote-reading, specific-gravity indicator uses two static pick-up tubes within a vessel. Two additional tubes are installed in a reference tank containing a liquid of known specific gravity. Comparing the unknown liquid with the known gives an accuracy of 0.001 sp gr units, with interpolation to 0.0005 units.

All functional parts of the unit are mounted on the rear of the instrument panel and are accessible for maintenance by opening the back panel door. Operating adjustments can be made from the front of the panel. Petrometer Corp., Long Island City, N.Y.

Circle No. **41** *on Reply Card*

Full-cone fog nozzle

. . . of Teflon offers unusual erosion resistance, often outwearing metals. Both wide angle (120°) and narrow angle (90°) cone spray patterns are available now, as well as hollow-cone models previously manufactured. The complete line includes nozzles with orifices from ⅛ to ½-in. diameter. Flow rates vary from 2 to 70 gpm.

The Bete spiral design atomizes the

PHOENIX QUALITY STANDS OUT ALL OVER

We needn't tell you what kind of life and service you demand from the pipe flanges you buy. The important thing to know is that you are ordering flanges which will be consistently high in quality. Phoenix drop-forged flanges *always* meet the highest quality and strength specifications. No one makes a better flange!

SPECIAL MACHINED FLANGES AVAILABLE
SPECIAL FACINGS • BORES • DRILLING • THREADING

Leading Manufacturers of Pipe and Tank Flanges and Commercial Forgings

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FLANGE AND FORGING DIVISION
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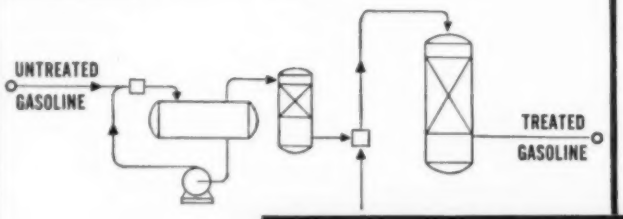
Integrated Manufacturing Facilities: FLANGE AND FORGING DIVISION, STEEL BAR MILL DIVISION, RUBBER PRODUCTS DIVISION AND HORSESHOE PRODUCTS DIVISION

TC SWEETENING



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COPPER CHLORIDE

Tennessee's Copper Chloride was developed to effect efficient Mercaptans removal.

CUPRIC CHLORIDE DI-HYDRATE

Place your confidence in a basic producer of Copper Chemicals.

Other products of interest— Ferric Sulfate—Copper Sulfate, Copper Oxide—Sulfur Dioxide.

For samples make request on your company letterhead.

TENNESSEE TC CORPORATION
617-629 Grant Building, Atlanta, Ga.

IN THE **SEPTEMBER** PETROLEUM PROCESSING

The 6th Annual

PETROCHEMICALS ISSUE

A SPECIAL INDUSTRY REPORT—will give you more valuable information about the fastest growing segment of the petroleum processing industry, "Petrochemicals." Don't miss this feature round-up of "Where We Are, and Where We're Going With Petrochemicals," plus the annual listing of petrochemical glossary. New this year will be a listing of engineering and construction firms serving the petrochemical industry.

fluid with no necessity for vanes or internal parts. Any particles smaller than the orifice will pass freely through, minimizing clogging. Each nozzle is made from a single piece of Teflon. Bete Fog Nozzles, Inc., 309 Wells St., Greenfield, Mass.

Circle No. **42** *on Reply Card*

Stainless steel

. . . and its fabrication: *Form Adv. 590a* is a 40-page manual on the approved techniques for fabricating stainless steels. Included are sections on cold forming, machining, annealing, painting and methods of protecting the material during handling. Also included are charts of stainless-steel properties for both the 300 and 400 series. Advertising Division, Republic Steel Corp., 3100 East 45th St., Cleveland 27, Ohio.

Circle No. **43** *on Reply Card*

Adding machine

. . . not only figures in feet and inches without conversion, but also handles fractions of inches as well. The Fractomator can be used by engineers, draftsmen, pipe fitters and others who deal with lengths normally expressed in fractions of inches as well. The Fracsize device there is no need to convert back and forth to decimals in adding or subtracting fractions of inches. It counts up to 100,000 and automatically totals inches-and-fractions to feet-and-inches

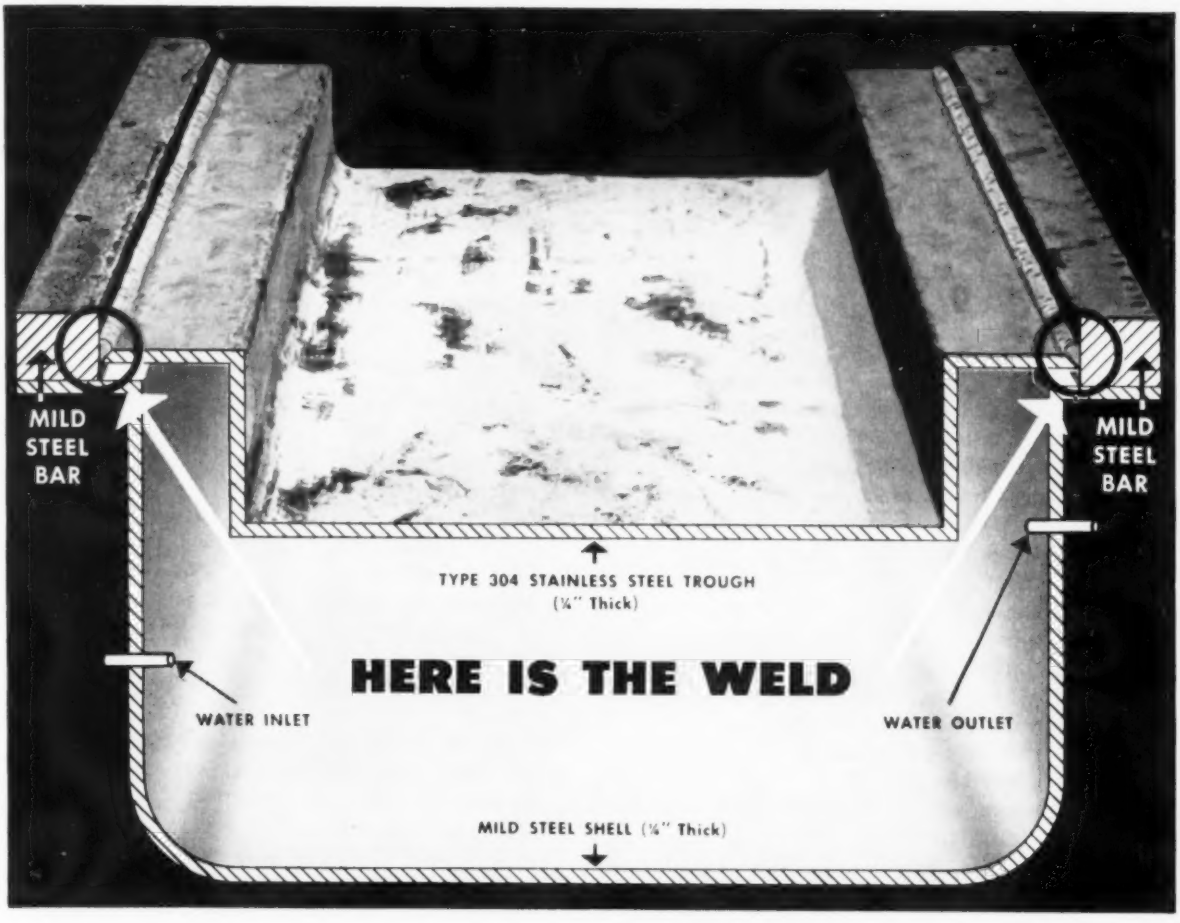
The machine is really two-in-one, with the front machine used for addition and the reverse side for subtraction. Both sides are synchronized to show the same result. For outside work, the machine comes in a leather case with a pad which fits a coat pocket. For office use several desk stands are available. The calculating machine is made in West Germany by Rechenmaschinen-fabrik C. Kubler and is available in this country from Alexander Drafting Equipment Co., 159 N. Daisy Ave., Pasadena, Calif.

Circle No. **44** *on Reply Card*

Corrosion guide

. . . for aluminum: *Corrosion Keys for Aluminum* is a graphic presentation of the yearly corrosion rate of more than 100 chemicals and other corrosive materials on this metal. How the rate of corrosion varies with temperature and the concentration of the corrosive chemical is cleverly illustrated in graphic color. Reynolds Metal Co., 2500 S. Third St., Louisville, Ky.

Circle No. **45** *on Reply Card*



No special equipment . . . No new training for the weldor

Inco-Rod "A" joins dissimilar alloys to fabricate chemical drag conveyor

Here's the way Inco-Rod "A"* electrode solves welding problems that often come up in the process industries.

The job was a drag conveyor trough at International Minerals and Chemical Corporation's Carlsbad plant. Made of 304 stainless steel, it carries magnesium oxide containing corrosive chlorides and sulfates coming from a rotary kiln at 1200°F.

The problem welds were the Joints between the 304 stainless and its mild steel frame – ninety feet of welding.

Using Inco-Rod "A" electrode, weldors did the job with standard equipment, and without special techniques. The joints were strong, sound, and crack-free.

Two possible alternatives to using INCO-ROD "A" electrode were both rejected as they would be likely to produce crack sensitive welds.

Dissimilar Alloy Welds A Maintenance Problem?

Try some tests on Inco-Rod "A" – the versatile electrode with the green flux coating. With stainless steels, low alloy or mild steel, high nickel, copper-nickel or others – you'll find you can usually count on strong, ductile joints of X-ray quality. And corrosion resistance in most cases will be equivalent to or better than either of the alloys being welded.

Inco-Rod "A" electrode can be used in all positions . . . gives a spray-type arc and easy slag removal. And because this *one* electrode welds *most* dissimilar alloys found in processing plants, your welding rod inventory problems are simplified.

More facts and figures on using Inco-Rod "A" electrode in dissimilar alloy welding are given in Inco's new folder "Inco-Rod 'A' Electrode." For your copy, write:

*Trademark of The International Nickel Company

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO-ROD "A" electrode is supplied in four diameters: 3/32-, 1/8-, 5/32-, and 3/16-inch . . . packed in 5-lb. containers.

INCO **Welding Products** · electrodes, wires, fluxes

 (To obtain more data on advertised products see page 126)

Why wait for anti-pollution laws?

ESSO Standard Oil Co. recently had as guests at its Bayway (N. J.) refinery some 50 air pollution and health officials. They represented not only the area in which the plant is located, but also neighboring towns and counties, and even the state of New Jersey itself.

Purpose of the gathering was to discuss air pollution at Bayway—the sources of air pollution and what Esso is doing to control and reduce them. Studies that the company made in 1952 indicated that the biggest source of atmospheric pollution at that time was from combustion operations in that plant—furnaces and flares. This source was charged with 52% of the pollution, evaporation with 32%, and catalyst dust (from cracking operations) with 16%.

Since then, Esso has been taking strenuous steps to reduce this pollution. Flaring has been cut 85%, the result of improved control of operations; 35 new floating-roof tanks have been erected; additional cyclones have been installed to recover cracking catalyst dust; a plant is now being built (by General Chemical Corp.) to take hydrogen sulfide from the refinery and convert it to elemental sulfur.

All of these steps are impressive. They have accounted for an estimated 65% reduction in Esso's contribution to air pollution.

But even more impressive is the attitude that Esso has developed toward the total problem of air pollution, and the openness with which it is willing to lay its cards on the table and discuss the subject in public. Many questions were asked by the state and municipal officials—and all were answered by Esso people in a forthright manner, without hemming and hawing. Not one was sidetracked or evaded.

As Ross Murrell, manager of the Bayway refinery, explained to the group at the outset: "We recognize air pollution as a problem and as our responsibility. Where we have such a problem, we want you to be familiar with it and with what we are doing about it."

E. R. "Randy" Wilkinson, manager of the plant's technical department, put it another way: "We as a company want to be good citizens, and more particularly we want to be good neighbors. We're more anxious than anyone else to clean up the atmosphere over the refinery. . . .The less our products are seen and smelled, the better we like it."

Wilkinson made an interesting observation on how far we can go in cleaning up air pollution. According to him, Esso hasn't reached the limit of improvement. "We can improve still further," he predicted. "As we skim off the cream in making initial improvements, we learn more about our operations—and more cream comes to the surface."

If all industry had Esso's attitude, and would spend the necessary money to reduce and minimize pollution, there would be no need for legislation to control pollution.

See where it leads?

WHILE we're on the subject of air pollution, look at what's happening out on the west coast.

Last month Los Angeles County put into effect a system requiring permits for the operation of air pollution control equipment. But to get an operating permit, you have to pay a fee—ranging from $20 to $500, and based on the size of the equipment.

You not only have to spend money to buy control equipment, but now you have to pay for the privilege of operating it. That's really getting it from both ends.

BENEFITS You can get with SULFAN®

(Stabilized Sulfuric Anhydride)

for Sulfonated Lube Oil Additives

and other

Emulsifying and Demulsifying Agents

BENEFIT No. 1 **Increase Yields**

Because of the extremely reactive nature of SULFAN, higher molecular weight compounds can be sulfonated to produce desirable oil soluble sulfonates. Treatment with Sulfuric Acid or 20% Oleum leaves these compounds unreacted.

BENEFIT No. 2 **Eliminate Waste Acid Problem**

Since water is not formed when SULFAN is used for sulfonation, the waste acid problem inherent in using Sulfuric Acid or Oleum is eliminated.

BENEFIT No. 3 **Improve Sulfonation Efficiency**

SULFAN has 99.5% SO_3 available for sulfonation reactions; thus, for many applications SULFAN offers nine times as much usable SO_3 as 100% Sulfuric Acid and over three times as much as 20% Oleum. This can mean a considerable saving in sulfonation costs.

BENEFIT No. 4 **Step Up Processing Efficiency**

The absence of waste acid when using SULFAN permits larger batch sizes or more rapid through-put in a sulfonation process. This means that by using SULFAN, batch size or through-put can be doubled or tripled without increasing the size of the equipment.

Tank Car Quantities

A laboratory development just a few short years ago, SULFAN today is a commercial chemical of ever-growing importance. This new processing tool is now being regularly shipped to many users in tank car quantities. For technical data on SULFAN, experimental quantities, or other assistance, contact any General Chemical office listed below.

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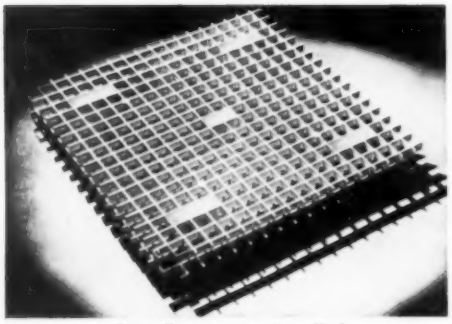
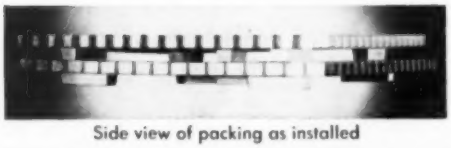
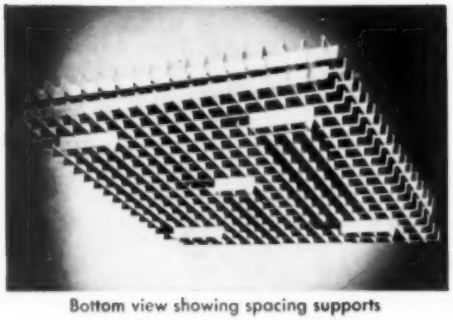
FLUOR'S NEW poly-GRID



Overall top view as installed



Side view of packing as installed



Bottom view showing spacing supports

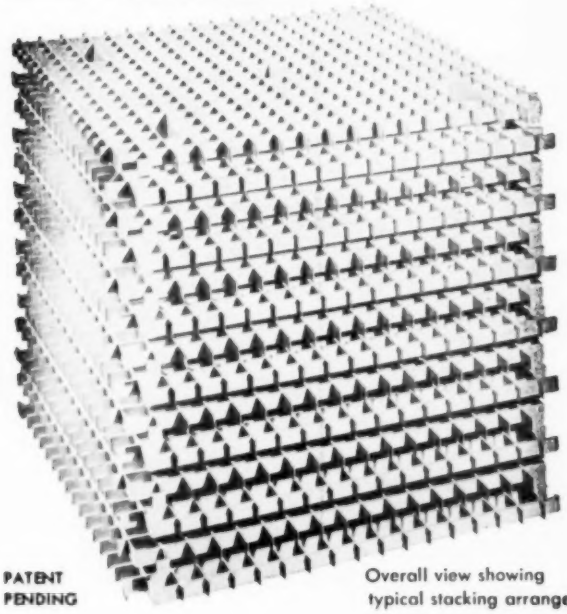
MORE COOLING IN YOUR EXISTING TOWER

To increase the throughput of your existing counterflow induced draft cooling tower, Fluor Products Company now offers "Poly-Grid" packing.

This revolutionary packing provides greater cooling surface — greater overall heat transfer; yet construction is open, and pressure drop low.

"Poly-Grid" is available in high impact polystyrene or linear polyethylene to meet all water conditions.

Fluor "Poly-Grid" packing allows you to cool more water under existing operating conditions, or to realize extra cooling of present throughput — all at minimum capital expenditure.



PATENT PENDING

Overall view showing typical stacking arrangement

Contact your nearest Fluor Representative for details.

POLY-GRID can be easily installed in any counterflow induced draft cooling tower—regardless of make or model!

Call him today!

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